

Edward Mylesmith Jr.

21 Beacon St
Boston.

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~~May 25th - 57~~

Presented to the Law Office
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May 12-27

OPERATIVE SURGERY

Presented to the Hon. O. C. C.

JOURNAL AND PATHOLOGICAL ANATOMY

by the Hon. O. C. C.

OPERATIVE SURGERY,

BASED ON

NORMAL AND PATHOLOGICAL ANATOMY.

OPERATIVE SURGERY,

William. W. Woodseys

BASED ON

Antiquae For

NORMAL AND PATHOLOGICAL ANATOMY.

BY

J. F. MALGAIGNE,

Professor Agrégé de la Faculté de Médecine de Paris,
Chirurgien de l'Hôpital de Lourcine, Chevalier de la Légion d'Honneur,
et du Mérite Militaire de Pologne, etc. etc.

TRANSLATED FROM THE FRENCH,

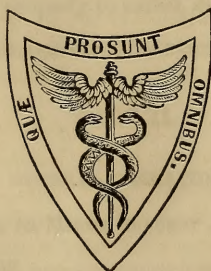
BY

FREDERICK BRITTAN, A.B., M.D., M.R.C.S.L.

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SÉCURITÉ, SIMPLICITÉ, CÉLÉRITÉ.  
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ILLUSTRATED BY WOOD ENGRAVINGS,

FROM DESIGNS BY DR. WESTMACOTT.



PHILADELPHIA:
BLANCHARD AND LEA.

1851.

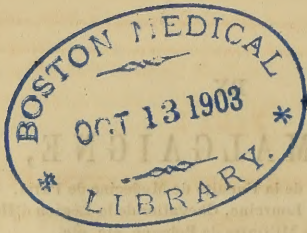
OPERATIVE SURGERY,

William W. Keen

BASED ON

Keen's

NORMAL AND PATHOLOGICAL ANATOMY.



1680

BY

FREDERICK BRISTOL, A.B., M.D., M.C.S.T.

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ILLUSTRATIONS BY WOOD ENGRAVING.

FROM DESIGNS BY DR. WESTMACOTT.



PHILADELPHIA:

T. K. AND P. G. COLLINS, PRINTERS.

1881

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TRANSLATOR'S PREFACE.

CONSIDERING the widely-diffused reputation of M. Malgaigne—the acknowledged high character and practical utility of his *Manuel de Médecine Opératoire*, which has already reached a fourth edition in the original, and has been translated into no less than five continental languages—the frequent references to, and extracts from it, as a classical work, by the most eminent surgical writers of this country—and especially taking into account the desire for information as to the practice of foreign schools—it has excited some surprise that no translation of so celebrated a book has yet been offered to the British Profession.

During twelve months' study in the schools and hospitals of Paris, in which the original is used as the standard work by students of all nations, the translator was able to appreciate its great value, not only as a companion and guide in the dissecting and operating theatres, but also as a complete book of reference for all that relates to operative surgery.

Whilst in France, and since his return, he has heard many of his professional acquaintance regret their inability to read it satisfactorily in the original; and believing that, notwithstanding the admirable treatises which have appeared during the last few years, there is still room for so comprehensive a book, he has, after obtaining the sanction of the author, determined to bring it more immediately within the reach of the British Surgeon.

The author's preface so fully affords information as to the plan and objects of his work, as to render further observation on these heads superfluous. The translator has, here and there, added notes with references, containing the details of some few operations omitted by the author; others which have been adopted and published since the date of the last edition of his work; and also the opinions and practice of the most celebrated English surgeons, where they have seemed materially to differ from, or conflict with, those of M. Malgaigne; and he trusts that the present publication may fairly be considered an Encyclopædia of the Operative Surgery of Europe.

A large portion of the work consisting of descriptive detail, the translator, to avoid the possibility of misrepresenting the author, resolved to follow him as closely, and literally, and in as simple lan-

guage as possible, occasionally giving the original of words of purely technical signification. If the style should occasionally appear cramped or confined, he hopes it will be attributed to his anxiety to keep this object prominently in view.

For the illustrations (which are an addition to the work) the translator is indebted to the valuable assistance of Dr. Westmacott.

CLIFTON, BRISTOL, *April 6, 1846.*

AUTHOR'S PREFACE.

THE term *Médecine Opératoire* was invented by Sabatier, to designate that portion of Surgery which is effected by the hand and the application of instruments. This was the real meaning of the word *Surgery* amongst the ancients, and long remained so; but moderns have attributed to it another; and, by a misconception that has prevailed, Surgery has become in the present day synonymous with *Surgical Pathology*. Moreover, we comprise under the head of *Médecine Opératoire*, properly so called, only an arbitrarily chosen portion of surgical operations; we exclude from it, for instance—at all events in France and on the Continent—the application of bandages, and the reduction of luxations and fractures, which are as essentially manual operations as the others; so that our terms are constantly at variance with facts; and our surgeons may be defied to point out exactly in what a surgical operation consists. Whence arises this confusion of ideas? To answer this question, we must glance over the history of this part of the art.

Hippocrates apparently intended to leave us a treatise on *Médecine Opératoire*. In the book "*De l'Ïétreion*," or *de officina medici*, to which we must join the works *de fracturis* and *de articulis vel luxatis*, he has described in an admirable manner all that relates to the general application of bandages, to the reduction of dislocations and fractures, and to some other operations. This is doubtless but an incomplete surgery; here and there in his other works we find operations that are omitted in this treatise; and there are others which he could not describe, since he forbade his disciples to perform them—for instance, Lithotomy. Celsus has drawn us a much more complete chart of ancient surgery: after having treated of *dietetics*, or of the diseases which are cured principally by regimen and pharmacy, or of the diseases that particularly require medicines, he comes to surgery, which needs the employment of operations, and divides it into two portions, according as it affects the soft parts or the bones. In the first, all the external diseases, which have already been treated of dietetically and pharmaceutically, re-appear: in fact, they only come under the head of surgery incidentally, and when dietetical and pharmaceutical means have failed; whilst the really surgical diseases, those which require the immediate aid of *Médecine Opératoire* alone, that is to say the diseases of bones, are precisely those which we have excluded from it.

You will see exactly the same division of surgery, properly so called, in Paulus Egineta; you will meet it again in Albucasis, the prince of Arabian surgery; and this is the reason why, with our modern views, we are astonished to find omissions in their surgical works which can only be filled up by referring to their books on medicine. But even at that time some Arabians, unskilled in operations, for instance Rhazès and Avicenna, excluded from their immense treatises the purely operative part, or only appended it to the history of each disease, no longer treating as one all the medical sciences. This was a new phasis long retained by the Arabs. In the thirteenth century, however, the Italian surgeons had collected into a separate science, under the special title of surgery, the history of all the external diseases, and their treatment; and such is the origin of that which we have since called *surgical pathology*. In this third phasis, as in the preceding, *Médecine Opératoire* is confounded with pathology; and we do not find the first traces of their new separation before the sixteenth century.

A. Paré was the institutor of this novelty. He wrote a special work for certain surgical operations: an incomplete essay; for he collected together, in this manner, only those operations which he had been unable to bring into his other books; and bandages, and diseases of the bones especially, were separately treated of. After him, Guillemeau, his pupil, published a much more extensive treatise, including bandages, and rejecting luxations and fractures; whilst in Italy, Fabricius ab Aquapendente, a more faithful imitator of the ancients, comprised, under the title of *operations*, all that which formed the *surgery* of Celsus. This attempt of Fabricius was lost, at all events for a long time; and the French school stamping its impress upon the teaching of surgery throughout Europe—we see that even M. A. Severin, the illustrious compatriot of Fabricius, excluded from the remarkable treatise on operations, which he entitled *Médecine Efficace*, that which the disciples of Paré had excluded. It would be superfluous to follow, step by step, in this particular, the progress of operative surgery. France, momentarily eclipsed by Italy, revived with Dionis, reigned with more than former brilliancy in the eighteenth century; created the name of *Médecine Opératoire* for that branch of surgery which she was the first to make distinct; and even now, in the nineteenth century, has no rival but England, who, under another name, that of *Operative Surgery*, embraces also other subjects—that is to say, all that was included in the surgery of Celsus, Paulus, and Albucasis,—fractures, luxations, and operations altogether.

On comparing, in reference to this point, the modes of instruction of the two nations, the English certainly have the advantage as regards order and method. We have divided that which they have properly combined; we describe but one-half of that science which they treat entire; and, it is probable that one day or other we shall adopt their mode of regarding *Médecine Opératoire*, and perhaps also the more suitable title which they have given it. Meanwhile, let us glance over the progress of *Médecine Opératoire* as it is still understood throughout the Continent of Europe.

Up to the time of A. Paré, operations, considered as therapeutical

indications only, were rather pointed out than described. The want of sufficient anatomical data hindered the giving of some details, and others seemed in a measure useless to students, who, having no opportunity of repeating them on the dead subject, could only learn them by watching the master himself: and the poverty of detail for each proceeding corresponded with the paucity of proceedings for each method. Moreover, as the yoke of authority still pressed with all its weight, writers generally confined themselves to copying their predecessors. Paré, rich in the results of curious investigation and long experience, and advanced pretty far on the road to unfettered examination, added several proceedings to those known before his time; but he only foresaw the utility of surgical anatomy, and directed his attention especially to the instrumental and mechanical portion. This leaning, forced in some measure by circumstances, is the essential character of *Médecine Opératoire* in that age; it showed itself in a very remarkable manner over the whole Continent of Europe: in Italy, by the work of André de la Croix; in France, by that of Guillemeau; in Germany, by the laborious compilation of Scultet.

Descartes commenced a new era for surgery as well as for the other sciences. Throwing aside the doctrine of the ancients, he forced the moderns to think for themselves, and the establishment of journals and academies most suitably favoured this still fresh ardour for reasoning and discussion. Louis XIV. at the same time established a special chair for operations; and, thus constituted as a separate branch of surgery, they began to be described as operations, and no longer as mere indications; and they were argued and discussed like all other parts of science. The book of Dionis is, in this respect, the most original and remarkable expression of the new epoch. He did for operations that which Mauriceau did for *accouchement*, and J. L. Petit for diseases of the bones. The *Médecine Opératoire* of Dionis, and that of the Academy of Surgery, which followed the same path, are liable, however, to serious reproach; the writers inherited from the preceding age a certain love of the instrumental and mechanical portion, and still too much neglected the anatomical part. It is a strange fact, and one that would be scarcely conceivable did we not know the influence of rival interests and self-love over the most perfect minds, that, when the Faculty of Medicine of Paris wished, in the beginning of the last century, to institute a course for the repetition of operations on the dead subject, the whole corporation of surgeons rose with great clamour against this innovation, which it denounced as rash and fatal. The *Médecine Opératoire* of the eighteenth century laboured, in addition, under the too exclusively philosophical ideas within the influence of which it had been founded. It has exploded with the past, and consequently presents but an incomplete and inexact view of the art.

Lastly, the *Médecine Opératoire* of modern times has better profited by the sources of light and progress offered to it. English surgery, moulded on pathological anatomy and experiment, after the example and lessons of J. Hunter, for a moment surpassed us; and so vigorous

was the impulse it received, that it is still almost our equal. We have not, however, delayed to follow it; and *Médecine Opératoire* in France has opened to itself two additional paths: first, the historical, the only way of appreciating the real state of the science, and finding out its weak points; secondly, surgical anatomy, the sole means of giving to the knife security in its progress, and to the proceeding clearness of description. Sabatier was the first to guide us to the study of history; but he has been far surpassed by M. Velpeau. The great surgeons, also, who first elucidated by exact anatomical details the difficulties of certain operations, Boyer and Dupuytren—to speak of those only who are dead—have been happily succeeded by M. Lisfranc, who has, in fact, given to the art a new physiognomy by precision of detail, and exactitude of description.

Perhaps, however, in the real progress made in our time by *Médecine Opératoire*, its end has been overlooked: whilst practicing the operations on the dead body, perhaps the living patient has been too much forgotten; whilst perfecting the operations, all that should precede and follow them—the indications and results—have been left in the shade. In the first editions of this book, I had stated, “A treatise on operative surgery, to satisfy all the requirements of the age, should, for each operation,—first, discuss the indications, exactly study the surgical anatomy, review all the proceedings, and, after mature examination and judicious choice of the best, describe the manipulation with all the necessary detail;—then point out the different methods of dressing; set forth a statistical account of successes and failures; and, lastly, seek in post-mortem appearances the causes of death in fatal cases, in order to point out their remedy.” But at the present day even these conditions no longer suffice. Experience teaches us daily that we must not regard as completely cured all those who apparently recover; and that it is extremely necessary to keep an exact account of the relapses, both in relation to the nature of the disease, and according to the proceeding adopted. This is not all; for, after the most positive cure, it is still interesting to study the consequences of each operation, as well on the organs and functions, as on the general vitality of the patient. Any observation that does not extend so far should be considered incomplete. This is almost a new field offering itself to the surgeons of the present day.

As to myself, so extensive a scheme could not be comprised in the narrow limits of a manual, and discussions were almost forbidden; it sufficed for me to present the results. I have consequently been obliged, much to my regret, to lay aside almost entirely the historical portion; I have only touched on the question of indications, in the appreciation of the different methods applicable to the same disease; lastly, the description of the dressing, the study of the accidents and of the consecutive treatment, would have drawn me farther than the limits of the work allowed.

The two principal parts of the art which have been treated of with especial care are, the surgical anatomy and the operative manipulation; and, in these respects, perhaps, this work has been made more complete than the treatises, even of much larger size, that preceded it.

To this cause it undoubtedly owes a success much greater than the author dared to expect. Notwithstanding a pirated Belgian edition, and five translations, it has taken but eight years to exhaust the first three editions, consisting of a great number of volumes; and though I intended it for students only, I have had the satisfaction of seeing it in the hands of masters. Moreover, it has had the honour of being frequently cited, and even translated or literally transcribed, in the new edition of Samuel Cooper, and in the excellent articles with which M. A. Bérard has enriched the *Dictionnaire de Médecine*.

I should have been, indeed, ungrateful for such encouragement, if I had not diligently revised all the articles in this book, correcting that which was not sufficiently exact, and supplying in each new edition the omissions of the preceding, whether owing to my own fault, or to the incessant progress of science. During the last two years especially, a powerful and unexpected impulse has been given to *Médecine Opératoire*. Strabismus has ceased to be an incurable deformity; stammering has been combated in every kind of way; a happy generalization of subcutaneous sections has rendered almost innocuous several operations previously dreaded. I have carefully included these precious acquisitions; rejecting, however, other attempts suggested by them (use engendering abuse), which have not the recommendation of scientific value nor practical utility. Several other operations have been improved, and, in some measure, remodelled; and, in this manner, sufficient matter has been collected to increase this new edition by about an eighth.

Another modification has also become necessary; the *reduction* of the old into the new measures. But, as many practitioners are not yet sufficiently familiarized with the new system, I have thought fit to draw up tables of comparison, at all events for the measures of length and weight which are frequently used in *Médecine Opératoire*.

August 10, 1842.

MEASURES OF LENGTH.*

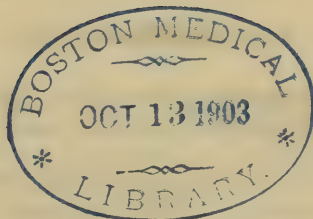
New Measures.	Approximate Value.	Exact Value.		
1 Millimètre.	1 Half-Line.	Feet.	Inches.	Lines.
1 Centimètre.	4½ Lines.	0	0	0.443
1 Décimètre.	3 Inches 8 Lines.	0	0	4.433
1 Mètre.	3 Feet 1 Inch.	0	3	8.330
		3	0	11.296
Old Measures.	Approximate Value.	Exact Value.		
1 Line.	2 Millimètres.	2 Millim.		256
1 Inch.	3 Centimètres.	27		072
1 Foot.	32 Centimètres.	324		864
1 Ell (<i>aune</i>).	1 Mètre 18 Centimètres.	1188		
The English Inch.	2½ Centimètres.	25 Millim.		399
The English Foot.	30 Centimètres.	304		794
The Yard. (3 Feet.)	91 Centimètres.	914		383

MEASURES OF WEIGHT.

New Measures.	Approximate Value.	Exact Value.			
1 Centigramme.	½ Grain.	lbs.	oz.	gros.	grs.
1 Décigramme.	2 Grains.	0	0	0	0.19
1 Gramme.	20 Grains.	0	0	0	1.88
10 Grammes.	2½ Gros.	0	0	2	18.82
100 Grammes.	3 Ounces 2 Gros.	0	3	2	44.28
1 Kilogramme.	2 Pounds.	2	0	5	10.80
					35.15
Old Measures.	Approximate Value.	Exact Value.			
1 Grain.	5 Centigrammes.	0	Grammes		033
1 Gros.	4 Grammes.	3			82
1 Ounce.	30 Grammes.	30			59
1 Pound.	500 Grammes.	489			50

* The following table shows the exact relation between the new French and the English Measures of Length and Weight.

Measures of Length.	
Mètre, the 1-10,000,000th part of the arc of the meridian from the pole to the equator	39.370788 inches. 3.280899 feet. 1.093633 yard.
Décimètre, 1-10th of a mètre	3.937079 inches.
Centimètre, 1-100th of a mètre	0.393708 inch.
Millimètre, 1-1000th of a mètre	0.03937 inch.
Measures of Weight.	
Kilogramme, weight of one cubic décimètre of water of the temperature of 39° 12' Fahr.	2.6803 lb troy. 2.2055 lb avoirdupois.
Gramme, 1-1000th part of a kilogramme	1.5438 grains troy. 0.9719 scruples. 0.032 ounce troy.
Décigramme, 1-10,000th of a kilogramme	1.5438 grain troy.
Centigramme, 1-100,000th	0.1543 grain troy.



OPERATIVE SURGERY.

PART I.

GENERAL ELEMENTS OF OPERATIONS, OR ELEMENTARY OPERATIONS.

WE comprise under this title the general methods to which recourse is had, in dividing, removing, or destroying the living tissues, by the knife, actual cautery, or ligature; and we shall add some words on the means proposed for diminishing, or entirely suppressing, pain during operations.

CHAPTER I.

INCISIONS. DISSECTIONS. PUNCTURES.

SECTION I.—INCISIONS.

INCISIONS, in their variety and applications, constitute at least one-half of operative surgery;—the opening of abscesses, the removal of tumours, the section of tendons, the ligature of arteries, amputations, the operations for strangulated hernia, for lithotomy, &c., are only incisions more or less modified. The importance of studying them need not, then, be discussed.

1. *Instruments.*

Some incisions are made with special instruments; for instance, the tenotome for the division of tendons, the cataract-knife, amputating-knives, the lithotome caché, &c.; but those which the surgeon is most frequently called upon to use are the bistoury and scissors.

Of the Bistoury, and its different Positions.—The ordinary bistoury has either a straight or curved edge. The straight bistoury, of any required length, should have its edge starting from the heel slightly convex, then gradually sloping to join the back, so that its point (very sharp) should be almost in the axis of the blade. It is well also to have, between the sharp edge and the handle, a portion of the heel blunt and rounded. The cutting edge of the convex bistoury should

be, at most, 2 to $2\frac{1}{2}$ inches long, the rest of the blade blunt, and of only sufficient length to enable one to grasp surely and easily the open instrument.

The blade of the bistoury should shut without spring, in order not to blunt the edge or point. When it is open, the blade should be firmly fixed in the handle, lest it should wound the fingers of the surgeon himself.

The different ways of holding the bistoury are reduced to five, called the "positions of the bistoury."

First position.—As a pen; the edge downwards, the thumb and index-finger placed on the junction of the blade and handle, the middle-finger on the flat side of the blade, the edge turned to the palm of the hand; the ring and little fingers serve to steady the hand.

Second.—As a pen; the edge upwards, the same as the former; only that the edge looks towards the dorsal surface of the hand.

Third.—As a carving-knife; the edge downwards; the thumb and middle finger placed on the articulation of the blade and handle, the index on the back and outside of the blade, the ring and little fingers pressing the handle into the hollow of the hand, the edge downwards. This position is varied in many ways;—thus, the thumb and ring-finger advanced more or less on the heel, or even on the cutting part of the blade, especially when the incision requires more precaution than force; if, on the contrary, force is wanted, the index leans entirely on the back of the blade, or is even flexed with the last fingers to embrace the handle, and the joint of the bistoury is grasped between the thumb and two phalanges of the index finger.

Fourth.—As a knife; the edge upwards, the same as the last, only the index-finger is placed on the external side of the blade, more rarely on the back, and the edge is turned to the back of the hand.

Fifth.—As a fiddle-bow; the thumb and middle-finger on the hinge of the bistoury, the index on the flat of the blade, the ring on the external side of the handle, the little finger raised, the edge downwards; if more solidity is required, the little finger also may be applied to the handle, and the resistance fixed against the cubital border of the hand.

Scissors.—The scissors are straight, curved on the flat or side, or curved in the edge; the last little used. The point should be rounded, the joint moderately tight, but having all its movements free, the handles parallel when shut. These are called Percy's scissors: to see if they cut well, Garengéot recommends trying them on a sheet of brown paper wetted.

Position.—The last phalanx of the thumb passed through the upper ring, the phalanx of the ring-finger through the lower, the middle and index-fingers placed in front under the *lower handle*, the little finger free.

Mode of action of the Bistoury and Scissors.—It was formerly thought that the bistoury acted always by sawing, the scissors by pressure: and on that account it was concluded that scissors should be rejected as causing less neat incisions, and bruising the parts. Now, it is

admitted that the bistoury also acts in some measure by pressure, and the scissors by sawing; and we are with reason advised to conjoin the two movements. We go further, and believe that pressure is in certain cases the best means of obtaining "*clean*" incisions, whence the necessity of extending and stretching the skin under the bistoury. Now, as this pressure is by no means so strong as with the scissors, we ought, in all cases when the parts may be divided at one stroke, to prefer them. The contusion is a chimerical idea; and as to the neatness of the incision, it is only necessary to compare the neatness of an incision by the bistoury with one by scissors on a compress, a sheet of paper, a layer of cellular membrane, or on the whole thickness of the lip in the operation for hare-lip.

In order to cause the bistoury to saw, we must draw the blade along on the tissues we would cut; with the scissors, in cutting a very thick or hard substance, we must slightly draw them away. It has been advised to steep our instruments in oil in order to make them cut better. This is only a theoretical idea, the utility of which is nowhere shown. A much better precept would be to elevate the temperature of the instruments to the *external temperature* of the body, viz. from 75° to 80° Fahrenheit, since experience tells us that cold metallic sounds pass with much more difficulty into the urethral canal, and that the razor cuts much better after being warmed.

METHODS OF OPERATION.

FUNDAMENTAL PRINCIPLES.—Incisions are made in two ways, viz. from the skin to the deep parts (or from without inwards), and from the deep parts towards the skin (from within outwards).

Incisions are made through the skin (ordinary incisions), or under the skin itself (subcutaneous incisions).

1. *Ordinary Incisions.*—Whatever be the method, the incision may follow five different directions. First, towards the operator. Second, before or from him. Third, from left to right. Fourth, from right to left; the bistoury being sometimes held in the left hand. Fifth, from above downward, as in the operation of lithotomy.

When the operator can choose, he should always place himself so as to make his incision from left to right, or from above downwards; the most easy and natural directions.

Incisions from without inwards are exclusively reserved to the bistoury. They are straight or curved, simple or compound.

The general rules are:—

1. To direct the incision so that its axis may be parallel to the axis of the limb; or to the course of the nerves or vessels; or to the muscular or tendinous fibres; or to the natural folds of the skin; or, lastly, to the greatest diameter of the tumour.

2. In order to lessen the pain, make your incision of its full length and depth at one stroke.

3. Let the skin be always extended before commencing the incision. This tension, to be exact, should be made from both sides at once, and in the opposite direction to that which the bistoury should follow. Many are content to hold or stretch one only, or even two

of these sides; but the integuments are liable to recede or pucker under the edge; and, besides, the operation is less easy.

4. During all the time, the operator should have the most perfect command of his instrument; so that it might not go too deep nor too far; and especially that he might not make a slip, and unnecessarily cut himself, his assistants, or the patient.

The first two rules may admit of some exceptions; the others admit of none. The last is especially important, and that which is most frequently sinned against.

1. *Simple Incisions.* *First proceeding.*—The skin may be extended in several ways.

1. With the hand applied flat, the thumb and index-finger separated.

2. With the ulnar border of the hand behind; the thumb on one side, the little finger on the other.

3. With the index-finger on one side, the thumb on the other.

4. With the ends of the four fingers placed in the same line in the direction the bistoury is to follow.

5. Drawing aside the skin on one side, an assistant doing it on the other.

6. Having the skin made tense by assistants, so as to leave the operator both his hands free. Each of these ways may be useful, according to circumstances.

The skin being sufficiently extended, the operator holds the knife in the third position, and plunges it perpendicularly to the required depth; he then lowers it so that the edge may make with the skin an angle of 45° ; cuts pressing and sawing both at once; and, in terminating his incision, brings his bistoury up again to the perpendicular, to avoid those semi-sections of the skin called tails.

The same plan is necessary in straight or curved incisions, only that for these last the tension of the skin must be varied according to the direction of the incision.

Second proceeding.—The skin being extended in the manner explained, we employ a straight or convex bistoury in the first, third, or fifth position, the edge inclined to the skin at an angle of 20° to 45° , and draw it lightly over the skin, without making any puncture at the beginning, or bringing it up perpendicularly at the end of the incision. The bistoury must be repeatedly passed over the same course, so as to divide layer by layer. Here “tails” are inevitable; but this inconvenience is light in comparison to the advantages to be sometimes derived from this mode of operating.

Third proceeding.—The operator raises a fold of skin; one end of which he gives to an assistant to hold; the other he holds himself between the thumb and index-finger of the left hand; this fold should be tightly held from top to bottom. The right hand, armed with the bistoury in the third or fifth position, draws its edge perpendicularly on the fold from heel to point with a pressing and sawing movement, so that one stroke of the knife may divide it from top to bottom.

II. *Compound Incisions* are very varied. They may be reduced to five principal forms: V, T, crucial +, elliptical \circ , and in the

shape of a crescent \ominus . They are subject to the following general rules:—

1. All the branches of compound incisions should be made by the first method of simple incisions.

2. When one incision falls upon another, the second should always terminate in the first, and not begin from it.

There are no absolute proportions between the branches of a compound incision; their extent varies according to the diameter of the limb or part wished to be uncovered.

3. When two incisions have to be made one above the other, the lower should be made first, so that the blood may not hide the situation of the other.

The easiest incision should generally be made first, as the others falling on it are shorter, and easier to terminate. Thus, in a Λ incision we begin with the right branch. Also, when there is a transverse incision, we commence with it.

Not one of these rules is absolute; there are even some cases in which it is necessary to break them.

The V incision is composed of two straight incisions, of which the second ends at an acute angle in one extremity of the first, and it should also pass slightly beyond the first incision, so that the angle of skin may be entirely divided and separated.

When the angle contained is almost a right angle, it is called an L incision.

The T incision is a straight incision, on the extremity of which another falls almost in the centre of its length.

The crucial incision $+$. The transverse incision should be first made in its whole extent; then the lowest branch of the upright should be brought to the middle of the first; and, lastly, the top branch should be brought to the point of union of the two others.

When the skin is engorged or indurated, and does not recede before the bistoury, we need only make two incisions—one transverse, the other perpendicular.

An \times incision may be made in the same manner.

An Elliptical incision, $\omin�$, is made by uniting two curved incisions at each extremity.

A Crescentic incision, $\omin�$, is made by two curved incisions, one of which is part of a greater circle than the other, so that they are united at their extremities, and enclose a crescentic bit of skin. The proceeding is the same.

We may, by uniting these incisions in different ways, obtain various figures; thus the union of a V upside down, Λ , and of a circular incision, gives the oval incision of many amputations. Many Vs joined form a star; but the study of these five is sufficient.

III. Incisions from within outwards are sometimes made with the bistoury, at others with the scissors (which, to speak accurately, cut from within out and from without in both at once). We shall only consider the mode of doing it with the bistoury. This is done with or without a conductor or director.

1. *Without a director. First proceeding.*—The straight bistoury

held in the second position is introduced by an opening already existing, or is plunged perpendicularly into a collection of liquid; it should then be brought to an angle of 45° with the skin; and passed on, dividing and making tense on its oblique edge the portion to be cut, and then brought out perpendicularly, to finish the incision. During the operation, the ulnar border of the left hand should be pressed on the skin behind the right, so as to hold it firm. If the operator wishes to cut toward himself, the knife must be held in the first position, the point directed backwards.

Second proceeding.—The straight bistoury being held in the fourth position, the operator makes a fold in the skin, passes the bistoury up to the heel through this fold, and entirely divides it in withdrawing his knife, causing it to cut from heel to point.

If the fold is small, it should be pierced and divided in the same cut, as is done in superficial abscesses.

Third proceeding.—A first incision having been made, if it is required to enlarge it, or join another to it, the bistoury, held flat in the fourth position, is passed under the skin as far as necessary; then, by depressing the wrist, and turning the knife with the edge upwards, the skin is pierced by the point, and the knife is drawn out, cutting the skin before it on its oblique edge.

Fourth proceeding. Flap incision.—This is only used in amputations. The portion which is intended to be cut should be raised with the left hand; the bistoury held in the third position, but flat, is to be passed through the base from side to side; and, in withdrawing it, or, if necessary, giving it a slightly-sawing motion, a semicircular flap is cut of any size required.

2. *With a director. First proceeding.*—A director is introduced under the skin to where the incision should end. The point of the bistoury is placed in its groove. The instrument in the second position, at an angle of 45° , is passed to the end of the director, cutting as it goes. Then it is raised perpendicularly, and brought out at the same moment as the director.

Second proceeding.—The director being introduced as usual, the bistoury, flat in the fourth position, is passed to the end of it; then the point is raised, and the edge turned up, both together, and the instrument made to cut its way out, as before explained.

IV. *Subcutaneous Incisions.*—They may be made with the common straight bistoury, with the tenotome or tendon-knife, or any other special instrument. Their essential character is the smallness and valvular nature of the opening, by which the instrument penetrates to divide the tissues underneath, which should not be exposed to the air. There are four different methods.

First proceeding.—The skin being extended, the bistoury is passed flatly under it to where the incision should commence; the edge is then turned upwards, downwards, or to one side, as the operator chooses, and the incision made so that it shall finish at the puncture of the skin.

Second proceeding.—A fold is made in the skin, and the bistoury passed through one side at the bottom; but, without penetrating the

other, the fold is then let loose, and the incision made as in the last.

Third proceeding.—The skin is forcibly drawn aside, and puncture of the skin, and the incision made as above. The incision being finished, the skin is let go back to its place, and then the puncture no longer corresponds to the incision. You are thus much more sure against the penetration of air,—a precaution sometimes unnecessary, sometimes indispensable.

Fourth proceeding.—The operator begins by making a small opening in the skin with the lancet; through this he introduces a blunt-pointed tenotome. This plan is much the safest and most prudent in situations where nerves or vessels might be wounded.

SECTION II.—DISSECTIONS.

Dissections are, properly speaking, nothing more than incisions of the cellular tissue. Sometimes we use the bistoury and scissors: sometimes the fingers, or the handle of the bistoury or director, serve to tear and separate the cellular tissue more quickly or safely.

When the bistoury is used, the skin should always be extended, as in ordinary incisions.

First proceeding. Free dissections.—When a flap of skin which has not contracted any adherences with the subjacent tissues is to be removed, we seize the border or extremity of it between the thumb and index-finger, stretching it away from the parts beneath; then the straight bistoury, or scalpel, held in the first position, is drawn from one side, or one end of the flap, to the other in one cut (that is to say, so that the knife may pass over the whole interval each time, and not bit by bit), as much as possible using the knife towards oneself. If a flap has to be dissected that is larger at one end than the other, as a ∇ , a $+$, a \cup , we should begin from the point, still passing over the whole interval at each cut, but more freely towards the base; or the instrument may be brought up towards the operator in the first position, and then from him in the second, and so on. This mode requires more skill and practice; but is more speedy and brilliant than the first.

If, on the contrary, only one border of a straight or elliptical incision is to be dissected, the cuts should be larger and more extended in the commencement, so that the flap is more separated at the centre than at the extremities.

If the subcutaneous tissue is loose and extensible, we may shorten the dissection by tearing, and destroying it with the finger.

Second proceeding. Dissection of adhering flaps.—The bistoury is moved more lightly, care being taken not to penetrate into the parts to be uncovered, and also to leave sufficient thickness to the skin.

Third proceeding. By layers.—The incision being made as above, a thin layer is raised with a good forceps, and cut with the bistoury or scalpel (held in the fifth position) horizontally beneath the point of the forceps. This mode is only used in delicate operations, as strangulated hernia. We may also use for the same purpose the point of a

straight bistoury. Or, again, each layer may be raised on the director, and divided, as advised for the subcutaneous incisions.

SECTION III.—PUNCTURES.

Puncture is sometimes the first part of incision, with which it is confounded; but, excepting in this case, and in some operations which come entirely under this class, as bleeding, vaccination, &c., we have only two objects in puncturing, either to explore a tumour, or to give exit to liquid or gas. We shall explain here the punctures with the bistoury, lancet, and trocar only.

1. *With the bistoury.*—The bistoury, held in the first, second, or fifth position, if much effort is not required,—in the third or fourth, if much thickness of parts has to be traversed,—is plunged briskly and perpendicularly at one effort to the required depth. This should be previously limited on the knife, by advancing the index-finger on the blade to the required distance from its point. The knife is then withdrawn perpendicularly, unless the opening is to be enlarged.

Sometimes the bistoury is plunged in obliquely, especially when we wish that the interior opening should not correspond to that of the skin.

2. *With the lancet.*—The lancet held as in bleeding (that is to say, the handle forming a right angle with the blade; the blade held between the thumb and index-finger, which are advanced ordinarily to the union of the heel and sharp part, sometimes nearer the point; the other fingers slightly flexed so as to form a resting part on their united extremities, or on the back of the phalanges) is plunged in perpendicularly, and in the same way withdrawn, unless we wish to finish by an incision, in which case it is used as a bistoury in the second position.

3. *Trocar.*—Before using the trocar, see that it is free in the canula. Grasp it so that the handle may be firmly fixed in the palm of the hand, by the three last fingers. Place the thumb on the union of the canula and handle; the index-finger so far from the point as to leave uncovered enough of the instrument to penetrate to the required depth, and plunge it well in. When you feel that it is in, place the index and middle fingers of the left hand under the thumb upon the rim of the canula, whilst the same fingers of the right hand, using a traction on the handle parallel to its axis, withdraw it from the canula. As the liquid escapes, press on the canula, so that the emptying and sinking of the parietes of the cavity may not cause it to be loosened. Direct, if necessary, the end towards the different corners of the cavity, at the same time compressing so as to squeeze out every drop of the fluid. Take care always that the end of the canula is not pressed against the tissues so as to stop up its mouth. In order to extract the canula, place the thumb and index of the left hand, one on each side of it, on the integument, then the first and second fingers of the right hand under the rim and the thumb on the orifice, and briskly draw it out, parallel to its axis, the fingers of the left hand preventing the integuments from being strained.

CHAPTER II.

CAUTERIZATION.

WE understand generally by cauterization the application of the hot iron, or some other substances called caustics, to a part whose organization and life is wished to be destroyed; but sometimes, also, it is used for other therapeutic ends.*

SECTION I.—APPLICATION OF CAUSTICS.

Caustics are used in a liquid, soft, solid, or powdered form. Their application is subject to several general rules, all founded on the important fact that caustics, even the solid ones, only act on becoming liquid.

1. Carefully wipe all humidities from the suppurating surface.
2. Protect the neighbouring parts, and especially those depending, covering them with plaster or lint.
3. Carefully sponge away the blood or serum which exudes during the application of the caustic.
4. After the cauterization, carefully remove, either with lint or lotions, any part of the caustic which might possibly remain undecomposed.

I. LIQUID CAUSTICS.—These are, acid hydrochlor., acid sulph., and acid nit., concentrated solutions of potash, of soda, of nit. silver, liquid ammonia, nitric oxide of mercury, the liquid deuto-chloride of antimony, the collyrium of Lanfranc (of which the yellow sulphuret of arsenic and the green oxide of copper form the base), the phagedenic water, &c.

Very recently, M. Récamier has employed in cancers, nitro-hydrochloric acid, containing in solution the chloride of gold. The proportion is gr. vi of chloride to 3x of hydro-nitro-muriatic acid.

Mode of Operation.—This is the same for all. The part being well wiped, plunge in the liquid a pencil of lint, or of fine linen, fastened on a bit of wood, sufficiently long, or held in a dissecting forceps. This pencil is carried into all the corners of the part to be cauterized with as much pressure as may be required; then remove the remainder with some dry lint, or, if the caustic has been carried to the bottom of a cavity, wipe it or wash it out with abundant injections.

It has been advised to cover the part with a piece of diachylum plaster or dressing, with a hole in the middle of the required size; an excessive precaution, but sometimes not to be neglected.

Appreciation.—The collyrium of Lanfranc, the phagedenic water, the solution of nit. silver, are feeble, and only employed in superficial ulcerations, as of the mouth, lips, or genital parts. The concentrated

* Cauteries are divided into the actual cautery, or hot iron, and the potential—a term applied to all other caustics.—F. B.

acids act instantaneously; therefore their action stops at a slight depth, and is easy to graduate. The eschar produced by them is dry, yellowish with nitric acid; black with sulphuric. The solutions of soda and potash act for some time after their application; it is on that account necessary carefully to remove the superfluity, and even then we cannot limit their action with any certainty. The liquid deutochloride of antimony rapidly forms a dry eschar, whose extent we can better limit; it is generally employed, and with success, in cases of poisoned wounds and warts, whose bases have been cut out; but, for tumours of a suspicious nature, the nitric oxide of mercury is better. It causes a dry and solid eschar, first white, then yellow, then black, which can be well graduated and extended to any necessary depth, and it especially disposes the subjacent parts to a speedy cicatrization. The new caustic of M. Récamier appears to have advantages over it. With the latter, we can cauterize deeply; it causes an eschar which is detached at the end of three or four days, and, after its removal, we may repeat the cauterization according as required. We are assured that its application is not very painful, which would give it an incontestable superiority over all others; in fact, all these energetic caustics cause acute pain, and we ought as much as possible to avoid employing them on large surfaces with nervous subjects. We have seen the nitrate of mercury cause violent colics, diarrhœa, and even bloody stools (Dupuytren).

II. SOFT CAUSTICS.—The principal are the ammoniacal pommade, arsenical paste, and that of chloride of zinc.

Application of the Ammoniacal Pommade (Gondret).—This pommade is made of equal parts of axunge and ammonia. A layer more or less thick and large, according to the effect wished for, is spread on linen or lint. This plaster is applied to the skin in the ordinary manner. After some minutes, the skin reddens, and phlyctenæ appear; ten or twelve minutes after the application an eschar more or less deep is formed.

M. Gondret uses it instead of heat in all cases of revulsion; thus, he replaces by this means the moxa, &c.

Application of the Arsenical Paste.—A soft and spreadable paste is formed by mixing with water the powder called Rousselot's.* The sore should be well cleansed or even refreshed with the bistoury, and covered with a layer of paste, a line or a line and a half thick, extending rather beyond the edges of the sore. On the caustic is then put some spider's web, or very fine lint-compresses, and a bandage to support all.

The eschar is made in a few days, and is detached between the tenth and twentieth, sometimes later, bearing with it the adherent paste, leaving a red, firm surface, covered with granulations and disposed to heal. Sometimes, especially on the nose, the eschar does not come off until the twenty-fifth day, and then it leaves the skin healed and sound beneath. One application generally suffices; but

* Rousselot's Powder.—This powder contains 0.22 of dragon's blood, 0.70 of red sulph. of mercury, 0.08 of white oxide of arsenic.

if there remain any bad-looking tissues, a second should be immediately applied. The wound should be dressed with dry lint; the cicatrix that results is thick, firm, white, and less unsightly than that which follows the knife.

This caustic generally excites sharp and burning pains, and has caused some accidents of poisoning (depending on its composition) when applied to large surfaces.

*Application of the Paste of Chloride of Zinc (Cauquoin).—*This paste is composed of chloride of zinc, and flour, in diverse proportions. No. 1 is made of two parts flour to one chloride of zinc; No. 2, three parts flour and one chloride of zinc; No. 3, four parts flour, one of zinc. The flour is mixed with the zinc with as little water as possible, and the paste is left in the air to attract its moisture, and thus acquire the elasticity and firmness required. M. Bureaud mixes the zinc and flour in equal proportions. He has also proposed to substitute the sulphate of chalk for the flour. M. Velpeau has remarked that the chloride of zinc becomes transformed into hydrochlorate on mixture with water. This latter is much cheaper, and has all the virtues of the former thus employed. He has also given other proportions for the paste; thus, to 50 parts of flour he adds 100 or 150 parts of hydrochlorate. This paste does not dry, does not deliquesce, and loses none of its caustic qualities by keeping.

M. Cauquoin has stated that this paste was elastic, and consequently could only be well applied on flat surfaces. To remedy this, he added to two parts of the chloride one part of chloride of antimony (butter of antimony); but, according to Velpeau, the first paste may be applied where you will, and as you will; so that the butter of antimony is useless. To apply this paste, you should first lay bare the dermis; then cut out a round piece of the paste of the size you wish the eschar to be, and of a thickness varying according to the thickness of the tissues and strength of the paste itself. If it be a prominent tumour, the paste should be graduated by adding to its thickness at the centre, or diminishing at the edges. The caustic acts cleanly at the bounds of its application without spreading, and to a depth in the ratio of the thickness of the paste; so that you may at one application destroy the deepest tumour, or the most superficial cancer.

III. SOLID CAUSTICS.—The most used are caustic potash, nitrate of silver, and conical or cylindrical caustics.

Application of Caustic Potash. First mode.—A piece of diachylum plaster, with an opening in the centre, of the required shape, but only half the size the eschar should be, is applied on the skin. In the middle of this opening is placed one or more bits of the potash, which should be covered by another plaster larger than the first, and then a compress and bandage.

After six or seven hours, the action of the caustic is exhausted, the dressing is taken off, and an eschar is found, double the size of the opening in the plaster, and of a brownish-yellow colour. It may now be split or cracked with the knife, or left to become detached of its own accord. In this way issues are made, and some abscesses opened. Care must be taken not to employ too much potash; a layer

half a line thick is sufficient to completely traverse the skin. Generally, the moisture of the skin liquefies the potash; but if it be too dry, as in old people, it may be moistened with a little saliva, or a drop of water.

Second mode.—In order to carry the potash to a great depth, Dupuytren made small cones of pure potash, from two to three inches in length, and from one inch to an inch and a half in diameter at the base. These are held in a long kind of pencil-case, and the base applied, if the surface is large and whole; the apex, if it be hollowed out, or full of holes. Care must be taken to protect the surrounding parts, especially those beneath; for the potash liquefies quickly and easily, and then has all the danger of the liquid caustics. M. Mayor uses only cylindrical pieces of the potash. These, sinking into the tissue of their own accord, acquire the conical form, so favourable for being pushed more deeply.

The potash applied to large tumours has the advantage of reducing the tissues that it touches into a kind of slough; and this slough, black, soft, and moist, is nothing but a veritable animal soap, which is very easily removed by wiping with a sponge, lint, or linen. Its application may then be repeated every day; the more so, as this caustic does not increase the irritation (Mayor). The eschar of the skin is rather harder; it comes off in layers at each dressing from the eighth to the tenth day.

Practice in the great hospital at Vienna.—Five parts of caustic potash are pulverized in an iron mortar, adding by degrees six parts of quicklime in powder. This mixture is put in a bottle stopped with emery. When wanted, a small quantity is put in a saucer, and sufficient alcohol or eau de Cologne added to make it into a paste, that can be easily spread with a silver spatula. A layer of this paste, about two lines in thickness, with the borders carefully circumscribed with a spatula dipped in alcohol, and of the exact dimensions (for the eschar will present exactly the same form), is applied to the skin. In five or six minutes, the skin is cauterized down to the cellular tissue, which is known by the appearance of a small gray line on the borders of the caustic paste. Then it may be removed, and the eschar washed with vinegar and water. If a deeper eschar is wanted, the paste should be left ten, fifteen, or even twenty minutes on the skin. The pain is very moderate, and generally less than that of a blister. Besides a very speedy action, this proceeding has the advantage of giving precise and sure results; the lime hinders the potash from spreading, and renders it more active by taking from it the carbonic acid it still contains.

Application of Nitrate of Silver.—Nitrate of silver, cast in cylindrical bits, which are fixed in the caustic case, or a crayon case, of silver, is applied by the base of the cylinder or the sides. Sometimes it is cut to a point. If we wish to use it on a raw surface, the latter should be wiped first; if the skin is covered by the epidermis, we must moisten it with a little water or saliva. The eschar is dry, superficial, white, and silvery at first; it soon becomes black, and falls off at the end of a few days. The caustic should be wiped before it is

replaced in its case. The nitrate of silver is also carried to great depths; but then it is done by special instruments, which will be described hereafter.

Pastiles.—We call thus, pastes composed in general of oxides of lead, of mercury, arsenic, &c., to which are given the form of cones and cylinders, in which form they are dried. These cones are thrust into different parts of a tumour, which is desired to be cauterized deeply, their action being graduated. Perhaps this mode is too much neglected in the present day.

IV. POWDERED CAUSTICS.—Formerly, the alkaline cinders of certain vegetables were used in this form,—the powders of the iris, sabinæ, &c.; the red oxide of mercury, and calcined alum. This last may yet be usefully applied in large wounds with luxuriant granulations. Experience shows that it keeps them down better than the nitrate of silver. The wound is wiped, and then a layer, a line or a line and a half thick, is spread over it. Two days afterwards, the caustic powder forms a sort of crust, under which the wound is found raw and red, and the granulations repressed. This application is repeated as often as necessary. There is no inconvenience to fear.

SECTION II.—APPLICATION OF HEAT. PYROTECHNICAL SURGERY.

There are two ways of applying heat: 1. The metallic cauteries, called the actual cautery. 2. Divers other substances, as water and oil boiling, the moxa, gunpowder, ignited phosphorus, &c.; we shall only speak here of the former.

OF METALLIC OR ACTUAL CAUTERIES.—These are composed of a handle, a shaft, and a cauterizing extremity. The handle, of box or ebony, may be fixed to the shaft, or separate, so as to serve for all the cauteries. It is composed of two parts, one in wood, polished on eight sides, and about three inches long, surmounted by the second, a kind of half pillar of steel, two inches long, and pierced by a square canal destined to receive the end of the shaft, which is fixed in it by means of a spring; the shaft and cauterizing extremity are of steel; the shaft, rounded except at the end where it passes into the handle, is about eight inches long, sometimes continued straight on, sometimes bent at an angle of 90° to 120° . The cautery is named according to the form of its expansion; it is called reed-like, when it has a cylinder about two lines long, and seven in diameter, rounded at its extremity, and continued in a straight line with the shaft; olivary, when the extremity is like an olive; conical, when it represents an obtuse cone of from an inch to an inch and a half in length, and three-quarters to an inch in diameter at the base; hatchet-shape, with a blunt edge, the back being about three-quarters of an inch thick; nummular, having a disk of about an inch and a half in diameter and three-quarters of an inch in thickness; octagonal, a quadrilateral plate with the angles beaten down; annular, when the shaft terminates in a spherical enlargement surmounted by an annular portion, like the crown of a trepan, and about half an inch deep. M. Mayor has on the same shaft two blunt edges forming a double hatchet. All these

may be very well reduced to three. The oval, octagonal, and nummular. They are heated in a portable furnace with a very bright charcoal fire. An assistant heats them to the required degree, the heat judged by the colour of the steel varies from gray to obscure red, cherry-coloured red, and lastly white, which indicates the highest degree. The hotter the metal the better it destroys the parts, and the less irritation is produced; so that the cautery heated to whiteness is far preferable. The instrument, being sufficiently heated, is firmly grasped in the hand, the handle being, if necessary, enveloped in a compress or cloth, and applied without delay as described in the following manner: it is then plunged into cold water, which, in some measure, re-temperes the steel.

The actual cautery is employed in three ways:—

1. *Objective Cauterization*.—The nummular cautery, heated to redness, is applied at a distance of about five inches from the part wished to be stimulated, and gradually brought nearer as it cools; one application is generally enough.

This cauterization causes the tissues to redden and swell, and occasions sharp pain, in fact produces an artificial inflammation, useful in cases of atonic ulceration, and certain scrofulous tumours. It has been proposed, for the same object, to hold burning charcoal in a pincers, with rings at the end, at a short distance from the parts, or to concentrate the sun's rays by means of numerous lenses; these methods are nearly forgotten.

2. *Superficial Cauterization*.—Consists in moving on the skin the hatchet-shaped cautery, heated to whiteness, and tracing with it, quickly and lightly, lines only affecting the skin. The number of these lines differs according to the effect wished to be produced; their direction is variable, but generally in that of the length of the limb. It is better (in order to prevent hesitation) to mark out the lines beforehand with ink, and only to graze the skin with the first cautery, so that it may suffice to pass over all the lines traced. A second may be used, or the first be heated again, if necessary, and passed without pressure over the same lines.

The double hatchet-shaped cautery of M. Mayor, by making two lines instead of one, shortens the operation.

The eschar of these lines is of the colour of gold, and at first seems only superficial; but it gradually enlarges, and enters the skin to a sufficient depth; after it comes away, the cicatrization is speedy, and remarkably tightens the skin of the part.

The integuments should never be divided; this injudicious proceeding, instead of re-establishing their elasticity, only weakens it more, whence we have often fungous excrescences and ulcers difficult to heal. It should be dressed at first with dry lint or linen, hot, or steeped in wine, so as to stimulate; when inflammation has set in, recourse is had to antiphlogistics.

3. *Cauterization*, properly so called, consists in applying the cautery, heated to whiteness, sometimes on open vessels, more frequently on unhealthy tissues, or on wounds of a bad character. The form of the cautery, and the precautions to be taken to preserve the neigh-

bouring tissues, vary according to the case and situation. With regard to the force with which the operator should lean, he should remember that the effects of the cautery go further than the cautery itself, and that, if he sinks it to the depth of three lines, the eschar will be two deeper.

To guard the neighbouring parts, it has been proposed to cover them with wet linen; but the water which would run from it would cool the iron. A piece of plaster or card-board, with a bit removed in the centre for the cautery, answers better, but both may be very well dispensed with. In cauterizing at some depth, tubes of wood or metal have been recommended. Percy, who says that they become hot too quickly, had one made of steel, one line in thickness, for the reed-shaped cautery. The most important thing is to cauterize quickly, so that the heat may not have time to affect the parts too far. If the parts are deeply situated, the wound which leads to them should be enlarged, and we should wait till the blood ceases to flow, or we may use with advantage the card-board canulas mentioned by Camper. We shall return to them in speaking of caries.

The pain occasioned by cauterization is not near so severe as would be believed, especially if the iron be heated to whiteness. It is only the pain of the skin which is very acute; on which account, it is a practice to dissect off the skin, when that is possible, before applying the cautery. The adipose glandular and muscular tissues are much less sensible; and still less polypi, anomalous and sarcomatous tumours (Percy). Finally, the bones are scarcely sensible at all, and we have seen the cauterization of them produce nothing but an agreeable itching (A. Paré). Moreover, old people bear it better than adults; and children, even very young, better than all.

CHAPTER III.

LIGATURES GENERALLY.

LIGATURE was known amongst the ancients for the removal of pedunculated tumours, and, in the operation for certain fistulæ, was improved and varied by Levret, advised in amputation by Wrabetz, and regarded in a more general manner by M. Mayor. It consists in strangling the parts, in order either to divide them gradually, or to suspend their circulation, and procure their separation by gangrene.

The nature of the ligature varies: silk, catgut, packthread, or wire made of lead or silver refined, have been chosen. Each of these substances may be useful; the essential point is that it be even and strong. If it be of silk or catgut, it should be soaped beforehand, so that it may be easily tied.

Mode of applying the ligature.—The general methods of application may be classed under two heads—the common, and the subcutaneous

—and only apply to visible tumours. Those which are situated in the deep cavities require special apparatus, which will be explained hereafter. The general rules are:—

1. Choose a ligature strong enough for the parts it is intended to embrace.

2. Include only a moderate thickness of the tissue. “*Qui trop embrasse, mal étreint*” (Mayor).

3. Never include the skin in the ligature. It should be incised or dissected first, unless the pedicle be very narrow, or the skin ulcerated or diseased. For instance, we tie, without previous section, tumours of the mouth, fungi, polypi, &c. Lastly, the precept to respect the skin is much more observed in the proceeding for subcutaneous ligature.

COMMON METHOD. *First proceeding.*—When there is only a slight thickness of tissue to be divided, it suffices to surround it with a thread tightened as may be thought fit; but when a conical tumour with a large base has to be tied, and the thread slips towards its point or summit, it must be retained at the base either with the fingers, or even by fixing in the base a forceps with a toothed point, until the constriction is made sure (Mayor).

Second proceeding.—When the pedicle is too thick, a needle armed with a double thread is passed through the middle of its base; the threads are then separated, and each pedicle separately tied.

Third proceeding (Mayor).—Applicable to tumours with very large bases, and which we would tie in numerous portions; large needles of steel, untempered (in order that they may take the required curve, and be less likely to break), are used, their length and size proportioned to the thread and space to be passed through. They should have a blunt point, and an eye near the head or point, as required. If the tumour is to be divided in three portions, two needles should be threaded with the same ligature, and directed beneath the tumour so as to traverse its base from side to side at equal intervals: if the eye is at the head of the needle, it must pass quite through; but when near the point it is sufficient to seize the thread and retain it while the needle is withdrawn by the same way as it penetrated;—or we may wait till the point of the needle has traversed the tumour, and then thread and withdraw it. The thread is then cut in three, and we have three ligatures which, between them, embrace the whole tumour. We could do the same thing with a single needle armed with one thread only, but the needle, after having crossed the tumour from right to left, must re-traverse it from left to right so as to leave three loops. If we wish to make more loops, that is to say, tie the tumour in more parts than three, we may pass several needles on the same thread, the proceeding being still the same. This passing of needles requires some precautions; we must do it slowly, and guide the needle on its entering with the right index-finger. If the base of the tumour touches important organs, instead of passing it below we should traverse the tumour itself, introducing the needle always on the most dangerous side, and bringing it out on the safest. With these precautions the vessels avoid or slip on one side of the instrument, and are rarely wounded; but if there is any

hemorrhage, leave the needle in the wound to act the part of a cork and apply a strong ligature under it round the base of the tumour, whence the blood springs.

SUBCUTANEOUS METHOD.—Applied for the first time by MM. Ballard and Rigal to the ligature of a bronchocele. We shall return to its description in the chapter relating to this affection, only remarking here that this proceeding is applicable to any other tumour in favourable conditions.

Mode of Constricting.

I. IMMEDIATE CONSTRICTION.—A first knot is made with the two ends of the thread, as tight as possible, an assistant securing it until a second is made. If the pedicle is large and resisting, after three or four days the division has commenced, and the ligature becomes loosened, and must be renewed three or four times. This plan is only adopted with small tumours.

II. CONTINUAL CONSTRICTION.—This consists in applying to the ligature an instrument which continually tightens it without its being touched. Tried by Levret, renewed by M. G. Pelletan, it requires the employment of resources to which we cannot trust either for solidity or force.

III. PROGRESSIVE CONSTRICTION.—Differs from the last in as much as the surgeon can loosen or tighten it as he chooses without changing the ligature. It is done in many ways, only varying according to the form of the instruments.

First plan. Vegetable or animal ligatures.—A first knot is made secure by a bow, so that it may be tightened at pleasure. The constriction is tighter or looser according to the degree of force with which the hands of the surgeon act on the two ends of the ligature. The instruments for tightening knots, of Levret and Desault, act in this manner, and their only use is that of permitting the ligature to be tightened at a distance from the knot when it is deeply situated.

Second plan. Metallic ligatures.—The two ends are tightly twisted together, and again twisted tighter some days afterwards.

Third plan.—The “*Serre nœud*” (Knot-tightener) of Graefe, an imitation of the tourniquet of Petit, is a shaft of steel pierced at one extremity by an opening through which pass the two ends of the knot already applied; at the other extremity is a vice which, in moving to one side or the other, elevates or depresses a movable screw, to which are firmly attached the two ends of the ligature. One single turn of the vice suffices to loosen or tighten the constriction—this instrument combines great simplicity and force.

Fourth plan. Serre nœud of Roderic, modified by Mayor.—That of Roderic is composed of small balls of wood, bone, or ivory, $\frac{1}{4}$ of an inch in diameter, traversed by a central canal. A few or many of these are strung on the two ends of the thread like a chaplet, and represent a movable tube; the first is pierced by two holes, so that when the tumour or part is separated, the balls may not escape and become unstrung; and the last is similarly pierced, in order that the ligature may be knotted on the interval between the two holes. M.

Mayor says this tube is too supple and liable to turn and twist when much constriction is made; he employs the small balls for only half the instrument, the rest he completes by a metallic tube. The remote end of this tube is furnished with a transverse plate, on which rests a small winch mounted on a plate of copper, in imitation of the tourniquet of Percy; the two ends are fastened to this winch, and, by causing it to execute one or more turns, the constriction may be carried as far as necessary. M. Mayor gives the last ball a sharp edge, so that it also may act on the tissues to be divided.

Appreciation.—If only a flap of the skin is to be divided, as in certain fistulæ, the first two plans are preferable; if an energetic constriction is wanted, the last two; but, setting aside the use of the little balls which may be employed in both, the vice of Graefe seems more easy to use, more simple and more powerful than the tourniquet of Mayor. The first attempts at constriction are generally painful, afterwards the parts gradually lose their sensibility with their vitality. If it is a part that is entirely separated from the body, as the ligature is tightened, it swells, enlarges, and becomes livid. The other symptoms depend on the nature of the tissues. When the division is slowly made, cicatrization generally occurs at the same time.

Precautions.—The following precautions should be observed:—

1. Tighten carefully and gradually, observing the effect on the living tissues, and on the ligature, which must not be broken.

2. If the tissue is soft and easily torn, do not strangle it at once; a too quick division might be attended with effusion of blood; it should be tightened once or twice a day.

3. If the tissues are hard and difficult to penetrate, carry at once the constriction as far as possible without breaking the thread, and repeat it twice a day.

4. If a local inflammation comes on, or unpleasant nervous symptoms, the ligature should not be tightened, but rather even loosened, until they have abated.

5. If, at any time, accidents sufficiently alarming to require the removal of the ligature or part itself come on, tighten the ligature as much as possible, and remove the part with the knife above the ligature, then tie all the arteries, the ligature acting the part of a tourniquet.

CHAPTER IV.

MEANS OF PREVENTING THE EFFUSION OF BLOOD.

HEMORRHAGE is one of the most dreaded accidents that complicate or follow operations. We should know, then, how to prevent it before, to suspend it during, and suppress it entirely after, operation.

SECTION I.—MODES OF GUARDING AGAINST HEMORRHAGE.

There are two: compression and ligature of the arterial trunk; the last is in itself a very complicated operation, and will be treated of hereafter.

OF COMPRESSION OF ARTERIES GENERALLY.—The compression is intended so to flatten the artery as momentarily to efface its calibre; whence, in order that it be exact, two things are necessary: 1. The artery must not be too deep. 2. It must rest on something firm or bony. When these conditions fail, we are obliged to compress the whole limb. We shall point out five ways.

1. *Compression with the fingers*.—First find the artery, recognizable by its pulsation; then choose the spot on which you will press, and apply on the vessel the thumb or the other fingers, observing the following rules:—

1. The pressure should be made perpendicularly to the bony surface on which it applies.

2. If the thumb is used, it should be applied across the vessel and like a seal; if the fingers, an horizontal plane is formed with their united pulps, and ranged along the course of the artery, so that the compression is made by the four fingers at once, whilst the thumb, placed on the other side of the limb, or on some neighbouring projection, furnishes a fixed point.

3. The pressure should be made as lightly as possible, sufficient only to efface the arterial canal—a very important rule, and one which we cannot violate without becoming horribly fatigued, and running the chance of relaxing the compression—the fingers become so worn out, and, as it were, paralyzed, that they no longer feel the pulsation nor position of the artery.

M. Lisfranc has given some very judicious indications for estimating the degree of force required. On the humeral artery, for instance, the thumb is applied on the outside of the limb, the three middle fingers on the course of the vessel. First, press lightly and try the pulsation of the radial artery; it is felt to become gradually weaker as the pressure augments, and at last it ceases altogether; the pressure is then sufficient, and it is useless to increase it.

4. The assistant, who compresses, ought to be placed in such a manner that he can see the steps of the operation without annoying the operator, or being annoyed himself.

5. If the fingers become tired during a long operation, press the fingers of the other hand on them; if that is not enough, another person may place his hand on them, or even take the place of the first, compressing the artery immediately above his fingers.

6. If, by a slip of the fingers, or of the patient, the vessel ceases to be obliterated, instead of doubling the pressure, it should be firmly and promptly re-established on the axis of the vessel, and perpendicularly to the osseous surface as before.

7. The compression should be continued until the application of some means for entirely stopping the hemorrhage. If, at any time, the operator needs a jet of blood to enable him to recognize the mouth

of the vessel, the assistant only slightly raises the fingers, without letting go the artery, and immediately reapplies them.

II. *Compression with the pad, or a kind of stamp*.^{*}—A small pad, or even a tightly-rolled bit of bandage, is placed on the course of the vessel and pressed upon. The rules are the same: with all the inconveniences of the first plan, this has besides the disadvantage that the artery cannot be felt. A pad fixed on a handle, and used as a stamp or seal, is less fatiguing, but is liable to get out of place, and is only suitable for the subclavian artery, and, perhaps, also, the abdominal aorta.

III. *The Winch* ("Le Garrot") is composed of a cushion, a strap, a plate of horn or wood, and a small baton of the same material, armed with a cord at its extremity. The cushion is placed on the artery, and the plate on the opposite side of the limb; these are fixed by the strap, which should be passed twice round the limb, and then fastened on the plate; the baton is then put under the knot on the plate, and turned round, whereby the strap is tightened, and the cushion firmly applied to the artery. An assistant holds the baton, or it is fastened to the strap by the cord at its extremity. It can only be applied to the thigh or arm, and acts by energetically compressing on the bone all the parts of the limb.

It is certainly the strongest and most sure of all the means of compression; but, in addition to its being only applicable on the middle of limbs, it is said to oppose the retraction of the muscles, and to contuse the skin; that is, if the compression is strong. We have used it, and seen it used in the *Polish campaign*, and we did not remark this contusion of the skin; but we found two considerable inconveniences.

1. The difficulty of loosening and immediately re-tightening it, to show the mouths of the vessels by the jet of blood.

2. The general constriction, which extends to the veins, hinders the return of the blood, and causes a flow of venous blood from the stump, which only ceases when the instrument is withdrawn.

IV. *The tourniquet of Petit* is formed of two square plates, slightly arched, the superior of which is brought nearer to or separated from the lower, by means of a screw fixed on the latter. Under this latter is fixed a pad, covered with chamois leather. Another pad, and a strap passing through the extremities of the plates, complete the instrument.

The plates being together, the pad under the lower is applied on the course of the artery, the free pad to the opposite side of the limb, and the strap is moderately tightened round it. Then the screw is turned, which, separating the two plates, presses the lower one on the artery, and establishes a sure and efficacious compression. Some apply on the artery the free pad. The editor of J. L. Petit has fallen into this error, which has been the basis of the construction of certain tourniquets, as that of Percy. Compression thus effected is difficult and untrue, as we know by experience.

^{*} A key is used for the same purpose, the handle being well covered with lint, so as to form a pad.—F. B.

The cushion that compresses should be pretty large; its effect is more certain, and the instrument is less liable to move or be upset.

V. *The ligature "en masse" of M. Mayor.*—A resource infinitely precious, when all the others fail. It has been already described under Ligature.

The compressor of Dupuytren, and other instruments of the same kind, are generally abandoned.*

COMPRESSION OF PARTICULAR ARTERIES.—We shall only point out here the arteries whose compression, before operation, is useful and employed. Their anatomical detail may be found in the articles on the ligature of them.

I. ARTERIES OF THE NECK, FACE, OR CRANIUM. *The primitive carotid artery.*—Easily felt under the skin, especially at its upper part, and resting on an osseous surface, it may be compressed with the fingers applied perpendicularly; but this compression is troublesome, on account of the trachea and larynx being so near. It is rarely had recourse to.

Facial.—The most easily compressible in the whole body, one finger is pressed on the border of the lower jaw, in front of the insertion of the masseter.

Temporal artery.—In front of the external ear, two lines from the base of the tragus; perpendicular compression very easy.

All the others escape from the pressure, or are so small that it is useless. If an arterial wound of the cranium bleeds, it is better to compress the wound than each of the small arteries, on account of the anastomoses and the facility of the operation.

II. ARTERIES OF THE UPPER LIMB. *Subclavian.*—Camper proposed to compress it with the thumb on the first rib, in the hollow over the clavicle. If the clavicle rises even a very little, the thumb is with difficulty plunged far enough, and moreover this compression would be very fatiguing here. Recourse is then had to a simple cushion, or a cushion with a handle, used as a stamp (or a large key with plenty of lint wrapped round the handle, by way of a cushion). But the success of the compression, depending on the movements of the clavicle and shoulder, is always doubtful. It is almost renounced. We think that, without relying on this with too much confidence, it may be useful sometimes, at all events, as a supplementary means.

Axillary artery.—1. Under the clavicle. Dalh wanted to compress it in this part on the second and third ribs. The fingers not being able to reach it, he invented a peculiar tourniquet. Compression difficult and unsafe. Properly rejected.

2. In the axilla. The artery may be very well pressed against the head of the humerus. The pressure is made with the last four fingers

* A very ingenious and simple instrument is sometimes used, consisting of two elliptical steel bars, joined by a kind of hinge. At this hinge is a screw, by moving which the free extremities of the bars, which are padded and lined with leather, are separated or brought nearly together. One pad is placed on the artery, and the other on the opposite side of the limb, and the screw turned so as to bring the two pads towards each other, thus compressing (as it only touches with its pads) but two points, the artery and the opposite side. It was invented with the idea of leaving the venous circulation free. It has no advantages over the tourniquet.—F. B.

only, or armed with a cushion. It must be remembered that the artery is situated at the union of the anterior with the middle third of the axilla.

Humeral artery.—Subcutaneous, and skirting the border of the biceps and coraco-brachialis, it may be compressed in any part of its length by the thumb or four fingers, or any kind of tourniquet. Too long or too strong pressure on this artery is very painful, on account of the nerves which accompany it.

We are told, when nothing hinders, to choose the lower third of the arm, as the radial and ulnar nerves are then some distance from the vessel. But, as it is always accompanied by the median nerve, this precept is of small importance.

Care must be taken in every case that the pressure is made perpendicularly to the humerus.

Radial artery.—Easily compressed in the lower third of the forearm, between the radius and the tendon of the flexor carpi radialis, where the pulse is felt. This compression is not much used.

Ulnar artery.—At the inferior third of the arm, by pressing the flexor carpi ulnaris against the ulna; still less used than the preceding.

Collateral arteries of the fingers.—In the whole length of the fingers toward the union of their anterior with their external surfaces.

III. ARTERIES OF THE BODY. *Abdominal aorta.*—M. Tréhan has compressed it successfully on the lumbar vertebræ, chiefly in thin subjects, the patient being so situated as to relax the abdominal muscles, and strong pressure being made on the abdomen, with the four fingers of the right hand placed in a line. It would doubtless be more sure if a cushion or pad was applied transversely across the artery. The course of the linea alba in the umbilical region marks where the pressure should be made; but it is especially at the umbilicus itself that the abdominal parietes may be most easily depressed. Six or seven minutes' pressure suffices sometimes to stop (without their returning) uterine hemorrhages after parturition, the uterus having had time to contract on itself. This plan may also be useful in lesions of the iliac arteries.

In the internal hemorrhages following parturition, M. Faure has advised, according to the plan of a foreign accoucheur whom he would not name, the compression of the uterus itself through the abdominal parietes.*

Dorsal artery of the penis.—Easily compressed at the base of the penis, between the index finger below and the thumb above.

IV. ARTERIES OF THE LOWER LIMB. *External iliac.*—Compressible through the parietes of the abdomen against the brim of the pelvis.

The pressure should be directed a little obliquely outwards. It is only done in cases of extremity, when we cannot compress below.

* In these cases, we firmly grasp the uterus with one hand, and with the other apply cold suddenly to the external organs, by means of cloths dipped in cold water. The uterus is grasped to produce an artificial contraction, and close the vessels, until the means employed produce a real one.—See Churchill, page 393.

Femoral artery.—1. On the pubis. Louis was the first who substituted this plan for the tourniquet in amputations of the thigh.

The thumb is applied, either alone or armed with a cushion, across the artery on the ilio pectineal eminence. It should be remembered that this eminence inclines forwards and downward at a variable angle; so that, in order that the pressure may be perpendicular, it must be made rather obliquely on the artery, upwards and backwards, forming with the horizon an angle of 45° . The compressor of Dupuytren may also be employed, and even, with some precautions, the tourniquet of Petit; the compression is safe, easy, and much used.

2. In the middle third of the limb. It may be compressed against the femur with the fingers, tourniquet, winch, &c. Care must be taken in each method that the artery is flattened directly on the femur.

Popliteal artery.—May be compressed opposite the joint with the fingers or tourniquet. The latter is to be preferred, on account of the mass of adipose tissue that surrounds the artery here. It is applied directly from behind forwards. This mode is very little used. The arteries of the leg or foot may be compressed in the places where we would apply ligature; but the compression of the crural arteries is more sure, and should be preferred.

SECTION II.—MODES OF STOPPING HEMORRHAGE DURING OPERATIONS.

During an operation we may have to contend against arterial or venous hemorrhage.

First plan. Direct compression.—Consists in applying the finger on the opening of each bleeding vessel, until the compression of the trunk is re-established, or the operation finished. Used when we have no other means of stopping the blood. (J. L. Petit.)

Second plan. Indirect compression.—Most used in the flap operation, and whenever the artery can be held between the finger and thumb; or for operations on the lips, ear, or nose, &c. Again, in certain cases of removal of tumours adherent to the skin, in which a crowd of small vessels pour out blood, and annoy the operator. It may be arrested by pressing with the fingers around the incision.*

Third plan. Ligature.—It is done in two ways. Sometimes the vessel being laid bare, a ligature is applied, and the vessel divided below it; or two ligatures are applied, and the vessel divided between them. In this way the operation is finished, without, if we may say so, blood being lost.

The other plan being the same as that after the operation, we shall say nothing of it here. Generally, the care of direct or indirect com-

* We occasionally use an instrument something like the ordinary forceps with hooked extremities and a spring catch, so that, when the artery is held by the points, the catch retains them together, and closes the artery until the ligature is ready. We have also a small kind of forceps with flattened extremities, that rests closed by its own spring; it is opened by pressing its two branches together, and is so placed on the artery. When the pressure is removed, it closes of itself, and tightly holds the mouth of the artery; they are small, and may be left hanging on the arteries till the operation is finished. They are very useful in operations on tumours or on the scalp.—F. B.

pression is confided to an assistant; the operator rarely takes charge of it himself. It is he, on the contrary, who generally places and tightens the ligature.

These different plans are applicable to veins as well as arteries. Let us add, that venous hemorrhages generally spring from one of two causes: 1. Mechanical obstruction to the return of the blood to the heart, as in compression by the winch, and the flow of blood is only stopped by the removal of this obstruction. 2. The violent efforts of the patient, which hinder the blood from passing through the lungs, and cause it to flow back on the *venæ cavæ* and their branches. This is especially the case in operations on the neck. It is remedied by making the patient take long inspirations, and then ceasing all efforts. Often two such inspirations suffice to arrest an apparently uncontrollable venous hemorrhage.

SECTION III.—MODES OF SUPPRESSING HEMORRHAGE AFTER OPERATIONS.

The blood, *after an operation*, may flow from the arteries, the veins, or capillaries.

(1.) *Capillary Hemorrhage.*

The tissues, at the moment of their division, retract in a greater or less degree; the capillary vessels are generally compressed by this movement, and cease to bleed almost immediately; but in some patients, either from idiosyncrasy or some morbid diathesis, the blood continues to flow in streams. This hemorrhage, though at first stopped, may break out some hours after the dressing. Sometimes immediate reapplication of the parts suffices to stop all these little vessels; at others, the blood appears, notwithstanding.

First proceeding.—After having carefully removed all the clots of blood from the wound, a sponge, dipped in cold water, should be alternately squeezed over and applied on it, and the bleeding surface be left exposed to the air during three or four hours, covered with a simple compress without bandage. It should not be dressed until afterward. This plan is generally adopted.

When the hemorrhage returns after the wound is dressed, the dressing must be removed entirely, and the wound exposed to the air. We must then see if the bandage was not too tight, the position too uncomfortable, or if the patient did not require bleeding.

Second proceeding.—If the first does not succeed, recourse must be had to the application of divers substances called *styptics*.* Such are:—

1. *Refrigerants.*—Sprinkling with very cold water, the application of moistened cloths on the wound or neighbourhood, the application

* *Matico.*—This plant has lately been introduced in England, and very highly recommended as a styptic and astringent. A leaf is wetted and applied on the bleeding surface, or a strong infusion may be used. It is employed *externally* in all cases of hemorrhage, and especially those occurring in the hemorrhagic diathesis and capillary hemorrhage; also, as a lotion in leucorrhœa and epistaxis. *Internally*, in diarrhœa, dysentery, hæmoptysis, and internal hemorrhage generally.—See Remarks on the Efficacy of Matico, &c., by Thos. Jeffreys, M. D.

of powdered ice, evaporating lotions of water and alcohol, ether and water, the mixture of Schmucker, or, lastly, camphor in powder, between two wet cloths, which is sprinkled when the water has evaporated.

2. *Absorbents*.—Soft and spongy-like substances, lint, fine dry sponge, German tinder, agaric, preferable to the preceding; or, lastly, spiders' web, more powerful than any. Or powdered,—as powdered gum Arabic or rosin, either sprinkled on the wound, or applied on little pellets of lint impregnated with them. The Arabs use hares' fur.

3. *Astringents*.—Either powdered, as alum, or better in the liquid state, as the solutions of sulph. of iron, sulph. of copper, of alum, or nit. silver, vinegar and water, lemon juice, the water of Rabel, creasote and water, water of Binelli, &c.

Third proceeding.—Cauterization. 1. *By Caustics*.—We no longer employ anything but the nit. of silver for leech bites, and sulph. acid, by the aid of a speculum, to the neck of the uterus after resection of this organ.

2. *By the Actual Cautey*.—This application is subject to more rigorous rules than simple cauterizations. Experience has demonstrated—1. That when the cautery is only half heated, whether it has been allowed to cool, or become cooled by the blood, it becomes attached more or less to the eschar it makes, and brings it away with it, and the blood continues to flow. 2. That it becomes attached also when the iron is applied very hot, if kept too long on the wound. 3. When the eschar is too thin, it falls too soon, and the hemorrhage recommences; whence arise these essential conditions,—that the cautery be heated to whiteness, applied promptly, and withdrawn before it becomes red; that the surface of the wound be completely wiped, and cleansed from blood or liquid when it is applied; and lastly, that the eschar be thick enough. If the first cautery acted too superficially, we should apply a second (Percy). We must add that these precepts, applied by Percy to all hemorrhages, have received a strong refutation by the experiments of M. Bouchacourt on the cauterization of arteries—experiments to which we shall return hereafter.

Fourth proceeding.—Compression, made by the fingers of an assistant, if the wound is small; sometimes by the flaps themselves, if it be larger. Usually we make small conical pellets of lint or agaric, and apply them with the base on the bleeding point, securing them by bandage. We may have recourse to plugging, which is only a form of direct compression or ligature *en masse*, in which case we follow certain methods indicated hereafter.

We can also very well unite styptics or caustics to compression. We saw a case of capillary hemorrhage from four wounds of the leg and thigh, in which we were obliged to compress the femoral artery on the pubes in order to stop the blood.

There are some difficult cases in which we would try union by the first intention where the above plans would not suit. In a blepharoplastic operation performed by Dieffenbach, the blood flowing in streams prevented the re-application of the flap. He first rubbed the

wound with dry lint, then tried ligature maintained only one or two minutes. Everything failed. He then well sponged the wound, and immediately applied the flap, pressing on it a moment to drive out the blood re-accumulated in the wound, and made his suture as usual. After a few minutes, the hemorrhage had disappeared, and the wound healed by first intention.

(2.) *Venous Hemorrhage.*

The veins seldom bleed after operations, unless under the circumstances already indicated. It is generally sufficient to compress them for some minutes with the finger, so that a clot may form, which stops the blood. If it still persists, we may employ all the means for capillary hemorrhage; or, again, indirectly compress the venous branches between the capillaries and wound. In fine, all the proceedings applicable to arteries are so also to veins.

(3.) *Arterial Hemorrhage.*

We may count no less than sixteen plans which have had, and still have, partisans, for cases of hemorrhage from the open mouths of arteries.

I. EXPECTATION.—We trust to the resources of nature alone. It is important to examine what ensues. J. L. Petit showed that the stoppage of the flow of blood was caused by the formation of a clot, of which the internal portion, conical-shaped and free in the arterial tube, is called the *plug*, and is united by its base to the external portion called the *cap*. Morand explained it by the retraction and contraction, or the shrivelling up of the artery; Pouteau, by the engorgement of the cellular tissue in the circumference of the extremity of the cut vessel. These three theories combine all that was known before the time of Jones. He discovered that all these circumstances contribute to the provisional or definite stoppage of hemorrhage; afterwards a coagulable lymph exudes from the cut extremity of the vessel, soon sufficiently abundant to separate the two clots, forming what Jones called the third clot. To these causes Koch has added the double influence of a particular action of the blood, which causes it to shun passing through the divided vessel, in the same manner as it ceases to flow from the umbilical artery when the umbilical cord is cut, and the want of suction on the part of the capillaries when the part the artery supplied is removed, as after amputation. Thus after amputations, Koch never touches the orifice of the vessels; but, as he uses a kind of indirect compression, it cannot be called pure expectation, and we shall come to his method hereafter. These causes do not always act all at once, but often a part suffices. It is allowed that the small arteries may be left to themselves. Often after having placed the finger on them during an operation, when the ligature is ready we cannot find them: they are sufficiently obliterated. This effect is even more sure when they have been drawn out, as, for example, the uterine arteries in extirpation of the womb. In fact, if this stretching is very strong, the large arteries even do not bleed.

Cases are on record in which the shoulder has been torn off, and the subclavian even has given no indication of hemorrhage.

II. TEARING.—As a consequent of these views, it has been advised to imitate nature, and stretch or tear the vessels so as to procure a strong retraction. This method has been rarely applied to the arteries themselves; but it is useful in the removal of tumours, whose communications and vessels render hemorrhage to be dreaded.

III. CRUSHING.—Ledran observed that the females of animals tear or crush with their teeth the umbilical cord of their young, and he thought this crushing to be the cause of the arrest of the flow of blood. He rubbed between his fingers and in the forceps the spermatic artery on removal of the testicle, and succeeded. Jones has demonstrated that this rubbing and crushing of the artery tears the internal coat. The flaps formed prove an obstacle to the blood, and favour the formation of the clot.

IV. TURNING BACK.—In order to hinder the flow of the blood, and give time for the clot to form, a plan has been invented of laying bare the artery for a short distance, and turning it backwards on itself. This plan, recommended for the intercostal arteries, appears to have succeeded on the arteries of a small size.

V. STYPTICS.—Small plugs of alum, sulphate of copper, &c., introduced into the openings of the arteries as actual stoppers, were long since recommended, but are very rightly fallen into disuse. The water of Rabel, and lately that of Binelli, and creasote and water, have been advised. They are useful only for very small vessels. For those of larger calibre pressure must be added, to which belongs the greatest part of the effect produced. The agaric, lauded in France by Morand, by Warner in England, according to the observations of the latter, succeeds well for small arteries, and even for those of the leg, but completely failed on the femoral. Fault is found with it, as also with spiders' web, and German tinder, that they adhere too much, and are with difficulty separated, and only after a long time. The sponge has this inconvenience in a higher degree: the granulations penetrate its porosities, and develop themselves in it, so that it is not thrown off for weeks. Often Dupuytren was obliged to remove the sponge by layers with a scissors and forceps. Lastly, rosin, combined with blood and lint, forms a solid hard layer, which sometimes irritates the tissues with which it is in contact.

VI. CAUTERIZATION, effected by fire only. We have already given the rules established by Percy for its application; for the arteries he used the oval cautery only. It is an unsafe method for large arteries; for, when the eschar is detached, the hemorrhage is liable to re-appear, and it can really be trusted to for small arteries only. But the experience of M. Bouchacourt tends to give to cauterization a greater efficacy, at the same time that it establishes new rules for it. If a conical bar of iron, of 3 lines diameter at its base and 1 at its point, heated to whiteness, is applied to the open mouth of the crural artery of the dead subject, the artery becomes charred, and retracts in a *cul-de-sac*; but there still remains a small opening equal to one-third the former size of the vessel. When the instrument is only heated to redness,

the carbonization is very slight, the shrinking more rapid and more marked; and, moreover, the end of the artery turns into its interior, as a finger of a glove pushed within itself. If there are no collateral branches, the end of the artery may be thus turned in to the distance of from an inch to an inch and a half or more. The collateral branches, small and cut off near the trunk, are drawn in with it, and augment its thickness; but the collateral branches, not cut, restrain or give it but very narrow limits. On dissection, the three tunics are found turned back together, and their extremity, pushed up more or less in the arterial tube, is shrunk together, and offers but a scarcely visible opening. In repeating these experiments, we have found that it was not necessary to heat the iron so much, and that it was well to approach and retire it alternately from the artery; as, in leaving it too long in contact, it becomes adherent to the portion doubled in, and is not easily withdrawn.

These experiments have not yet been tried on living animals; but everything tends to make us believe that the result would be as good, in which case these two new rules should be laid down for cauterization of arteries.

1. That the cautery should be moderately heated, below even obscure red heat.

2. That its application to the mouth of the vessel, a little prolonged at first, should be afterwards made in an interrupted manner, but at very short intervals.

VII. MECHANICAL PLUGS.—We have said that cones of alum and sulphate of iron, &c., are introduced, but are little relied on. For a long time wax has been recommended for obliterating the arteries of the teeth, or those in the interior of bones. Divers analogous plans have been tried on the arteries of soft parts.

1. *Wax introduced in the form of small sticks*.—If the operator, while pinching the end of the vessel, pushes, from above downwards, this stopper, soft and easy to mould, either with the fingers or forceps, it becomes a tight lump, which is with difficulty driven out by the blood (Velpeau).

2. *The Stylet*, which Chastanet seems to have used for irritating the interior of the artery (Velpeau).

3. *Catgut, or a Gum Elastic Bougie, &c.*, which is pushed in to the depth of an inch. M. Miquel d'Amboise found by experiment, that, when a foreign body, especially a bit of catgut, is introduced into the artery of a dog, there is constantly developed a morbid state which renders the artery incapable of receiving the blood, although not mechanically obliterated. This method, combined with ligature, is useful when we find an artery ossified. It has been employed by Dupuytren and Roux in such cases on the advice of M. Manec. This observer, however, who made many experiments on this subject, says he has constantly seen the internal coagulum formed round the foreign body become decomposed after some time, so that hemorrhage is likely to occur unless a solid clot is formed between the foreign body and the first collateral branch.

VIII. DIRECT COMPRESSION.—Made by the aid of lint or agarie, as

we have said; except that, when we have only one artery, the pyramid ought to be applied by its summit (Petit made it in a case of emergency by means of the fingers of assistants renewed and replaced from time to time, and by the application of a special instrument); it is usually combined with cauterization, and in the flap amputation it is combined with réversion.

IX. INDIRECT COMPRESSION.—Made at a distance from the wound on the course of the artery, ordinarily by the tourniquet; it is safer to combine with it direct compression (at all events at first), and it facilitates the formation of a coagulum.

Plan of Koch.—After amputation, the operator brings back the flap and applies it on the wound, and maintains it by gummed bandages. A long compress is fixed on the course of the artery by means of a simple bandage; a slightly elevated position is given to the stump, and an assistant makes pressure with the hand on the stump for two hours, or as long as any considerable pulsation is felt. When that has disappeared, and the dressing is reddened by the lymph that has exuded, all danger of consecutive hemorrhage is passed, provided the patient rest quiet (Koch). Soon, also, the lymphatic exudation ceases, and the dressing becomes cold, dry, and stiff.

X. FLATTENING OF THE ARTERIES.—It is a sort of special compression, the first idea of which belongs to Desault. He used, according to Percy, different little instruments of wood, in the shape of forceps, with which he was not well satisfied. Percy imagined a plan of enveloping the artery in a strong bit of lead, which he afterwards flattened as much as possible with pincers. After many successful trials on animals, he applied this plan on the femoral artery of an old woman fifty-six years of age. The lead came off on the twenty-second day, and the success was complete. The method consists in passing under the arterial tube a lamella of lead curved semicircularly, about three-quarters of an inch broad, and some lines thick. This is squeezed into a circle, and then pressed by pincers, so that one-half of the vessel is folded against the other. This is especially applicable to arteries uncovered for some distance. For arteries gaping on the surface of a wound, Percy recommends small rings of lead, not very thick, carried over the extremity of the cut vessel, which is seized and drawn towards the operator; the ring is passed up from a pair of forceps closed; the artery is then held by the points of the forceps and the ring passed down from them on it; the ring is then flattened by another pincers, the first being retained until the vessel is well stopped. The same surgeon more lately substituted, for the bit of lead, pincers of steel, whose branches were held in the proper degree of proximity by a small button sliding along a slit made in their length—so far it is like the usual button forceps; but its branches are terminated by two little movable plates rolling on a pivot, so that the instrument may be turned on either side of the wound, without the vessel ceasing to be laterally compressed. This plan seems inferior to the other, as it leaves a foreign body in the entire depth of the wound; which, moreover, drags the vessel by its own weight. The method of flattening is quite forgotten.

XI. LIGATURE.—Described by the ancients for ordinary wounds; applied by A. Paré in amputations; comprises a number of methods, according to the parts included with the artery—the kind of ligature—the mode of tightening the ligature and the disposition of the cut ends:—

1. *According to the parts included.*—A. Paré seized with the tenaculum the veins and arteries, raising with them a little flesh or surrounding tissue, and tied them with a double ligature, thinking that in this manner the union of the vessels would be better and more effectual. Dionis passed the thread through the flesh by means of two curved needles, or even took in together vessels, flesh, and skin. Desault first in France recommended tying the artery isolated; when the vein was with it, he comprised that also in the ligature. Now the immediate ligature, or that which includes only the artery, is preferred.

2. *According to the kind of ligature.*—Single or double simple thread was used at first. Ruysch proposed copper. Vetch and Lawrence employed very fine silk. Physick thin shreds of doe-skin, and also metallic ligatures; others, silkworm's gut, cat-gut, &c. In France, single or double thread is still preferred, or small thread ribbons for the large arteries.

3. *According to the instruments used.*—The tenaculum of A. Paré has given place to the dissecting or button forceps, reproduced with slight modifications under the name of "fixed forceps of Graefe or Amussat." Some have used straight or curved needles. The tenaculum of Bromfield has regained favour lately. S. Cooper recommends a double tenaculum. M. Columbey has constructed a very ingenious instrument, which at the same time seizes the vessel, places and tightens the ligature—an instrument too complicated ever to become of general use.

4. *According to the way of tightening the ligature.*—Dionis relates two very remarkable ways; one in which the artery is tied on a little compress, and which, more lately applied to the operation of aneurism, has taken the name of Scarpa's method. The other consists, after embracing the artery in the ligature, in passing the thread through it from side to side before tightening, a plan reproduced by Sir A. Cooper. Jones advises the finest possible ligatures, and that they be squeezed tight enough to cut the internal tunics of the artery. Jamieson proposes soft shreds of doe-skin, moderately tightened, for the sake of guarding these same tissues.

5. *According to the time the ligature remains applied.*—Jones and Travers have stated that the ligature, applied from six to twenty-four or fifty hours, and then removed, suffices to obliterate the artery. This is called temporary ligature. Most of the surgeons of the eighteenth century leave hanging from the wound one extremity of the ligature, by which to withdraw it when the artery is completely divided, cutting off the other near the knot. Vetch, in 1806, proposed cutting off both ends near the knot, and uniting the wound, leaving the ligature to the efforts of nature. Moreover, it is especially to favour their absorption that ligatures of animal matter are used.

Appreciation.—Surgeons in this respect are divided between two

opinions; some, siding with Jones, think that, in order to hasten the adhesion of the sides of the artery, its internal coats should be divided; others, with Crampton, Scarpa, and Jameson, declare that this precaution is useless, and even hurtful. There are facts for and against each theory. Ligatures, too fine, have the inconvenience of often cutting the artery before adhesion of the clot and obliteration have taken place; ligatures, too loose, are sometimes driven off by the shock of the blood. The ligatures should then be chosen of different sizes, according to the calibre of the vessels, and sufficiently tightened to prevent their coming off. No other parts should be included in the ligature with the vessels, unless it cannot be avoided, or when the parietes of the vessels appear diseased, in which case they would be divided too soon. We have seen above in what cases we may tie the artery on a foreign body in its interior. As to the substance used, it is of little importance, when we do not wish to unite by the first intention; but of much in the opposite case, for then, if we leave the threads hanging out of the wound, the cicatrization is retarded; if vegetable threads are left in the wound, they are liable to determine numerous consecutive abscesses. The metallic threads seem to rest without inconvenience in the tissues, but they have only been tried on dogs as yet. We prefer the ligature of doe-skin, not soft, as Jameson likes them, but rolled up, as used by Physick and Dorsey, and strong enough to bear as much tightening as necessary. They divide the internal coats like vegetable threads, but are easily absorbed, so that we may remove the two extremities very near the knot; if, on the contrary, common thread is used, only one end is cut, and the other hangs from the wound. Larrey adopted another plan, not without some importance. He cut the ligature on a level with the external wound, and left the ends in its depending angle, so that the thread is out of the way of pulls and strains, in the after dressing, and especially when the patients, being delirious, tear off the dressing themselves. No matter what the length of thread, it must be left until it comes off of itself; that is to say, until it has entirely divided the artery. Temporary ligatures are properly rejected. These preliminary observations made, let us proceed to the operation.

1. *Immediate Ligature. First proceeding.*—The surface of the wound being well sponged, seek the vessels. There are two things that may assist us in finding them. 1. In many operations, the surgeon knows beforehand the situation the vessels ought to occupy, and he looks for them there, searching among the tissues with the point of the forceps. 2. Make the assistant slightly diminish the pressure on the arterial trunk, and observe the points from which the blood spouts. The jet of blood points out the artery; the vessel is then seized with the forceps, either by placing one of its points inside, the other outside (Desault), or seizing the entire vessel obliquely, so as to flatten it between the ends of the forceps, drawing it out a little; the assistant then passes a thread under the forceps, makes first a loose knot, and, holding the ends of the thread firmly in the palms of the hands with the three last fingers, he passes the two first along the thread, and with them directs the knot on the artery above the forceps, and

tightens this knot by pulling apart the two ends of the ligature with the index fingers. Another assistant, if necessary, places his finger on this knot, that it may not loosen, and adds a second in the same way. Now, but not before, the surgeon may withdraw his forceps, and the compression may be loosened to make sure that the artery is completely obliterated.

Sometimes the blood, flowing in streams, hinders a good view. The patient should then be made to take large inspirations; or the compression on the limb, perhaps too tight, should be removed or lessened. Sometimes the vessels retract into the flesh under the aponeuroses. If they are small, they may be left; if large, the flesh or aponeurosis which conceals them must be cut with the bistoury. Often a vessel which has bled during an operation does not do so after it is over, which is one reason for not always using the same mode of dressing. Desault's plan is only fit for large arteries, and then perhaps the tenaculum is preferable. With regard to the very small arteries, as it would be impossible to isolate them immediately, a small portion of the cellular tissue is raised, and tied with them. In the same way are employed the forceps of Amussat or Graefe, only that these remain closed by some particular mechanism. They are very useful when the surgeon, without assistance, is obliged to tie the ligature himself.*

Second proceeding. The Tenaculum.—The artery is transfixed by the instrument, and drawn out. The rest of the operation as usual.

The tenaculum may also serve for the small arteries; the artery and a small portion of the cellular tissue being raised together.

2. *Mediate Ligature.*—The two ends of the ligature are passed through two curved needles. The first pushed into the flesh, at a distance of half a line from the artery, is passed up two or three lines, and then brought out, having described a semicircle. With the other needle a similar semicircle is described on the other side. The vessel is thus between them, quite surrounded, and we have only to tighten the ligature. The same needle may do for both semicircles, one after the other.

XII. *INVERSION (Amussat).*—It consists in seizing the artery transversely in the forceps; then with another forceps, whose branches terminate in cylindrical bars, well polished, of half a line in diameter, and two-thirds of an inch long, called the forceps “à baguettes,” the artery is crushed above the first pair of forceps. This crushing is sufficient to break the internal tunics; then pressure is made up the vessel, so as to invert and roll upwards the tunics, which become folded in the interior of the vessel, like the finger of a glove inverted. The blood stopped by this fold forms a coagulum more speedily, and the coagulum has more points of attachment. Successfully applied on dogs. It has only once been tried on man, and then in a case of aneurism. It did not succeed.

XIII. *TORSION.*—Vaguely pointed out by Galen, renewed by Amussat. In the present day, it has much success.

Proceeding of M. Amussat.—The instruments necessary are four

* See note, p. 47.

forceps; two ordinary ones, a forceps à baguettes, and a fixed forceps, called a torsion forceps.

With an ordinary forceps, the free extremity of the artery is seized; with a second, the vessel is isolated, and drawn out half an inch or more from the surface of the wound. This done, the second forceps is replaced by the torsion forceps, with which the artery is grasped transversely at its extremity. This forceps being pressed together, and held in the right hand, the forceps à baguettes is taken in the left, and the vessel seized transversely with it, on a level with the flesh. Pressure is made with this forceps, so as to cut the middle and internal coat of the vessel, and, whilst it is squeezed with sufficient force, the torsion forceps is rotated on its axis, describing half a circle, as if we wished to roll up the artery on its points, taking the forceps à baguettes as a fulcrum; after which, the forceps is brought back to a position in which its axis is parallel to that of the artery, and rolled between the fingers, causing the vessel to make seven or eight turns on its axis. The operation is then finished, and with the torsion forceps the artery is pushed back into the flesh—at least if the torsion has not been carried so far as to break this twist, and withdraw it in the forceps.

Fricke's proceeding.—The end of the artery is seized with an ordinary forceps, and gently drawn out half an inch, more or less. Then this first forceps is transferred to the left hand, and with another forceps held in the right hand, the vessel is disengaged from the neighbouring tissues, which are pushed aside; then pressing on the origin of the vessel with the thumb and index finger of the left hand, with the right the first forceps is turned seven or eight times on its own axis. M. Velpeau adopts almost the same method; only he twists the artery, according to its size, from three to eight times.

Proceeding of M. Thierry.—He is contented with seizing the artery in the ordinary forceps, and giving it six or seven twists on itself.

The first proceeding is preferable, as, if the artery be not fixed, the torsion may extend to the first collateral branch.

The four forceps recommended by Amussat are not absolutely necessary. Forceps are made whose points are surmounted by the bars, which may replace the special instrument; but with two torsion forceps of this kind we may execute M. Amussat's proceeding very well, though perhaps not with as much facility as with the four.

Torsion, thus performed, tears the internal tunics of the artery, like a ligature; but, in addition, especially when the forceps à baguettes is used, it inverts them like the finger of a glove. The coagulum is firmly retained by the inverted internal coat, and by the twisted external coats. When the artery is healthy, torsion appears preferable to ligature. With small arteries there is no need of so much precaution. They may be seized and drawn out of the wound with a forceps, and twisted (without being fixed) on a level with the flesh. The ultimate branches do not even require to be disengaged: they may be merely seized and twisted *in situ*.

XIV. THE SETON.—Mr. Jameson proposes to traverse the vessel with a seton of doe-skin, two or three lines broad. His experiments

on dogs and horses have perfectly succeeded. M. Carron du Villards obtained the same success in passing a vegetable thread, or metallic wire, across. M. Dionis and Astley Cooper joined this method to ligature; and, notwithstanding the reprobation of several surgeons, we think this subject demands serious attention and fresh experiments.

XV. ENLACEMENT.—New method invented by Stilling, which consists in making two small incisions in the artery, at a distance from its mouth, equal to the size of the vessel itself. Between these incisions there remains a little slip, which is raised with the forceps, and the end of the vessel is passed under it, so as to form a kind of knot. It is a sort of seton formed by the artery itself. This operation has been once tried on man, and succeeded well; but it lasted three quarters of an hour. Torsion is evidently better.

XVI. "LES MACHURES."—Temporary ligatures having succeeded in certain cases, it was tried whether rupturing the internal coats a number of times in a small space would cause obliteration. M. Maunoir, in 1820, seems to have imagined for this purpose a forceps without teeth, which is most analogous to those of M. Amussat (à baguettes). M. Carron du Villards says he has succeeded in the same way on animals; but M. Amussat has made many trials of this kind, without obtaining obliteration once. This plan, alone, is then rejected: but, conjoined with ligature, promises singularly happy results.

Proceeding of M. Amussat.—The ligature being applied, the artery is seized transversely above it, and squeezed in the forceps à baguettes, so as to rend the internal tunics in all their circumferences, without injuring the external. We may make one, two, or three mâchures. The ligature serves here only to favour the formation of the coagulum; but, remarkable to say, the coagulum adheres to the circumference all round where the internal tunics have been ruptured. But it still retains its conical form, and near the collateral branches all that portion of the cone which passes beyond the mâchures is wanting; but nevertheless the adhesion to each rent is not less solid.

This proceeding, yet new, it appears of great importance to try. If its efficacy is confirmed on man, we have no doubt that it will one day be substituted for the others; at all events, for large arterial trunks.

CHAPTER V.

REUNION.

SOMETIMES the wounds which result from operations are left to suppurate—sometimes we try to heal them by the first intention. For these purposes we use position, bandages, sticking plasters, and sutures. The first two do not belong to our subject.

SECTION I.—STICKING PLASTERS.

Some are applied cold, others must be warmed over a candle or fire. The English isinglass plaster requires to be moistened. There are several ways of applying them.

Ordinary Method.—The edges of the wound being held in apposition by an assistant, we begin by fixing one end of the strip of plaster on one side of the wound; then, supporting the opposite side, we apply to it the other end of the strip—well extended. Above all, it is necessary that the skin be well dried and wiped. The length and breadth of the strip vary according to the case.

Proceeding of M. Gama.—The strips should be cut at least one inch broad, and long enough to reach twice round the limb, or part where the wound is situated. These strips are rolled up at each end on the unprepared side. The middle part between the two rolls is then applied to the point diametrically opposite to the wound, and the two rolls are carried round the part. The edges are thus brought together with the greatest possible firmness. After having crossed the ends one over the other, we finish the second turn. This plan is infinitely superior to the first—it assures a close, solid, immovable coaptation of the lips of the wound, and is not subject to unroll or loosen. If more than one strip is necessary, we leave intervals between them, in order to enable us to see the wound, and apply topics or leeches without removing the dressing. If there is reason to fear that the arterial trunks may be compressed, lint or compresses are placed near their course, so as to keep the strips at a distance. After three weeks or a month, the plasters are removed, and the wound is found healed.

Proceeding of the Ancients. Dry Suture.—Sticking plaster of sufficient breadth, and as long as the wound, was applied on either side of it, and the edges sewn together with a common needle and thread. Others cut the border of the plaster next the wound in digitations, and sewed, to these digitations, ribbons, which were tied from side to side. In all these cases, the cloth should be placed with the selvedge inside, so that it may not unravel with the stitches.

Lastly.—M. Roux, who sometimes uses this plan, makes eyelet holes in the plaster, through which he passes a thread, and brings the two sides together in the manner of stays. This is totally abandoned.

SECTION II.—OF SUTURES PROPERLY SO CALLED, OR BLOODY SUTURES.

Before the reforms of the eighteenth century, we counted no less than fifteen different kinds of sutures for wounds of the ligaments; now we have only four, which may be very well reduced to two.

1. *General Rules for Sutures.*

1. The wound should be well washed and freed from blood or other foreign substances.

2. At each fresh stitch, the edges should be brought together anew, so that the points may perfectly correspond.

3. The integuments ought to be traversed at an angle of forty-five

degrees; if more obliquely, we should raise a portion too thin to bear extension.

4. The thread ought to penetrate so deeply as not to leave a space under it where the pus might collect.

5. We must avoid pricking nerves, vessels, serous membranes, or tendons.

6. If the needle is passed from without inwards, the skin should be held between the thumb and index finger of the left hand; if from within outward, the thumb and finger should be pressed one on each side of the part to be traversed by the needle.

7. When suppuration is feared, a space should be left open at the bottom of the wound, in which may be placed a bit of lint.

8. The distance between the points of suture varies according to the thickness of the flesh. The general rule is, that they must be so near together that the wound may not gape between them. The distance should be the same between them all; but the extreme stitches should be only half this distance from each end of the wound.

9. The distance between the edge of the wound and the point also varies; it ought not to be more than half an inch, nor less than one line; it should be equal on both sides.

10. Generally, the threads are first placed in the middle of the wound; but if there are any angles or a free border, as in the lip, we should begin at the angles or free border.

11. The stitches should not be tightened until all the threads are in; and the rule is, that those of the middle, or angles, should be first tightened. The edges of the wound should be held together by assistants until the last thread is tied.

12. The knots ought always to be made on the side, as far from the wound as possible; and, lest they should be injured by the pus, we should place them on the least declining edge.

13. The knots ought to be tight enough to hold in apposition the edges of the wound; but not so tight as to cut the skin when the inflammation comes on, and the parts swell. This is a very necessary precaution.

14. When the wound is recent and fresh, the suture is left *in situ* from four to eight days. If it is to be united by second intention, the suture should remain applied a month, or even more if anything opposes the adhesion of its borders.

15. Only one stitch should be removed at a time, and we should always begin with those least essential, those we tied last. The knot being cut with a scissors, and the edges held together by an assistant, the thread or needle, according to the kind of suture, is withdrawn from left to right, the thumb and left index finger being pressed on the part from which it is drawn. We judge by the adhesion of the wound in this spot whether the others may be removed, or we should still wait longer.

2. Particular Sutures.

I. INTERRUPTED SUTURE. *First proceeding.*—Prepare as many threads as you intend making points or stitches, and thread two curved

needles with each thread. Carry the first needle, held as a pen, to the bottom of the wound, and push it through from within outwards, at a suitable distance. Pass the other needle in the same way on the other side. Withdraw the needles and tie the two ends of the thread, either in a double knot, or a bow, in such a way that the knot may not touch the bleeding surface. You may use only one needle, in which case you commence by passing the needle from without inwards on one side, and then from within outwards on the other.

Second proceeding. (Lafaye).—One needle is armed with a measured thread; the edges of the wound being held together by an assistant, the needle is passed from right to left at once through both edges. It is then again passed in like manner further on, and so on, leaving a loop between each stitch. These loops are then cut, and each point separately tied.

In this proceeding, we must evidently commence at one end of the wound and go through to the other, but we should always begin tying the loops in the middle.

Third proceeding. (Lavauguyon).—To unite the three edges of a T-shaped wound. We use one thread with two needles. We pass each needle from without inwards at each angle, so that the loop of thread holds together the two angles; then we repass each needle from within outwards above the transverse incision, where we tie the extremities of the thread. For the crucial incision the plan is the same, only the ends of the thread, in tying, ought to form a loop above the second vertical incision.

II. GLOVER'S SUTURE.—The proceeding is the same as Lafaye's for the interrupted (only that the loops are drawn tight instead of being cut), and only tied at each end of the wound. Little used.

III. QUILLED SUTURE.—Is done in the same way as the interrupted, only the needles are armed with double threads, so that one of the extremities forms a loop. All the stitches being made on the same side, and in the same line, a bit of sound or quill is passed parallel to the wound through the loops, and the ends of thread on the other side of the wound are separated, and tied over a similar bit of sound, with sufficient force to bring together the sides of the wound. Some have advised also to tie the bits of sound or bougie—a practice almost fallen into disuse.

IV. SUTURE WITH NEEDLES.—Is made with round straight needles of gold or silver, or with common pins.

First proceeding. Twisted Suture, properly so called.—One of the needles is taken between the thumb and middle finger of the right hand, the index finger pressed on its head, and the edges of the wound are brought exactly into apposition. It is pushed in at a distance of one or two lines from the border of the division from right to left, from without inwards for the first flap, from within outwards for the second. This first needle placed, we pass under its two extremities a thread, the ends of which are confided to an assistant, who pulls them tightly, so as to bring together the edges of the wound; then a second is placed with the same precaution, and a third, or as many as are wanted; then, taking the ends of the thread

from the assistant, they are crossed in front of the first needle, and brought again under its extremities, so as to form a figure of 8, repeated four or five times; then they are passed under the second in figure of 8, and the others in the same way, either with the same thread, or, if it is too short, another joined to it. When the last turn is made, the two ends are tied in a knot or bow. To insure the skin from being pricked by the ends of the needles, a small compress of lint is placed under their points. Some have advised to cut off the points with a strong pincers or pair of pliers. The best plan is to have cylindrical needles, to which is fastened, when needed, a lance point of steel, which is easily taken off after the operation.

Second proceeding. (Dieffenbach).—In all the cases where the skin is very thin, or the stitches should be very close together, M. Dieffenbach uses small pins (those for fixing insects), which he bends after having passed them through, so that the ring they form holds the edges of the wound together without thread. The ends of the pin may be cut off almost on a level with the edges.

Third plan. (Rigal de Gaillac).—The innovations of M. Rigal relate to two essential points: the passage of the needles, and their support. For passing the needle or pin, he fastens it in a handle ("Porte-aiguille"), almost in the shape of a caustic-case, but solidly mounted, so as to give all the force possible to the surgeon. Notwithstanding the inconvenience of adding another instrument to the list, passing the needle is often so difficult and long by the ordinary method, that I have, without reserve, adopted this instrument; and I think no surgeon, after once using it, would like to dispense with it.

Having introduced the needles, instead of retaining them by twisted threads, M. Rigal places under each end a long strap of cerecloth or plaster, slit in the middle, so that one end of the strap, applied on the skin on one side of the needle, serves to draw it down and diminish its traction, and the extremity of the slit sustaining the needle replaces the twisted thread. This plan only suits when the needles are strong, and separated by a certain interval; but it has a real advantage when the retraction of the skin is increased by a muscular lining. I have used it with success in the operation for hare-lip.

Appreciation.—The Glover's suture tends to bring together the points or parts through which the needle passes, and to pucker the edges of the wound. It ought only to be used when these points are very near together, and may always be replaced by the interrupted. It is said that the latter ties up the parts in a ring of thread, which inevitably cuts them, when the inflammation causes them to swell. But this accident is common even with the twisted suture, when too much tightened. We should mention that the suture, with needles only compressing the flesh in two points, is much less likely to cut them than any other. As to the quilled, it unites very well the bottom of the wound, but leaves the edges open; and, if we wish to bring the quills closer, it has all the disadvantages of the interrupted. It is useful in very deep wounds, where the essential thing is, above all, to unite the bottom. Unless, in this case, we replace it by the interrupted, modified in the following manner:—

Before tying the threads, a graduated compress or roll of plaster, as wide as the space between the point where the needle entered and that where it came out, is placed between the threads, along the wound, and the thread tied over it in a bow. In this way, the loop of thread, instead of being ring-shaped, is elliptical, as in the quilled. Moreover, with the bow, if the inflammation is too great, we can loosen the thread at will.

Latterly, two other plans have been proposed in hernia and hare-lip, by MM. Bonnet, of Lyons, and Mayor, of Lausanne. They resemble the quilled and twisted suture. We shall speak of them in the chapter on the operations for which they were invented.

Whilst speaking of sutures generally, we must not omit that Percy wished to substitute lead wire for all the other means. He attributes to it various virtues. "It suffices to twist or untwist it, to tighten or loosen the ligature. The wire may be round or oval, and does not cut as the thread does. The loop it forms can ply itself according to the neighbouring parts, whilst the needle is always straight and stiff, and the thread almost always takes a circular form, and it irritates much less."

These praises are to be suspected; the last, especially, is very hypothetical. Nevertheless, it is fair to say, that the lead might be substituted, in many cases, for ordinary thread, if it were not for these two inconveniences: it becomes oxidized, and breaks too easily; and, moreover, we have no sure, and, at the same time, simple means for carrying it through the thickness of the tissues.

CHAPTER VI.

OF THE MEANS OF DIMINISHING PAIN DURING OPERATIONS.

WE shall only just mention: narcotics, employed before the operation—animal magnetism, which succeeded once on a woman whose breast was removed by M. J. Cloquet—questioning the patient to distract his attention, a plan not to be disdained, and which Dupuytren often employed in dislocations—celerity in operating; that is to say, as far as the safety of the patient will admit.

A more direct means consists in always, when incisions are made, commencing them on the side next the origin of the nerves, so as to cut off the communication with the brain, and thus rendering any consecutive incisions less painful. But the experiments of James Moore are more important, because they tend to constitute a general method for operation on the limbs, though he only tried it on the leg. He had made a sort of compressor like Dupuytren's, furnished at its posterior extremity with a cushion, destined to compress the sciatic nerve, the anterior extremity being traversed by a screw terminated by a cushion, intended to press on the crural nerve. In order to find the point at

which it is most easy to compress the sciatic nerve, draw a line from the summit of the great trochanter to the sciatic tuberosity; the suitable point is at a distance of about an inch above the middle of this line; the anterior pad ought only to bear on the crural nerve, and a little on the artery, so as to leave the vein free, and to prevent engorgement of the limb; so that, when the operation is proceeded to, the artery needs special compression. It requires about one hour and a half to destroy all the sensibility of the nerve. A trial of this instrument was made by Hunter. The patient felt no pain during the incision of the skin and muscles, but complained a little when the bone was cut. The vessels having been tied, the instrument was removed, when a very small artery required to be tied; and the patient declared that it gave him more pain than all the rest of the operation.

Moore convinced himself, on his own person, that the sensibility and motion returned perfectly a few minutes after the instrument was removed.

I tried to apply the instrument of Moore in a case of false ankylosis of the knee that I wished to destroy. I should say, first of all, that, in following the direction of the English surgeon, I could not find the nerve; and I was obliged to seek more correct indications on the dead subject.

The sciatic nerve emerges from the pelvis, immediately above the inferior border of the sciatic notch, and, before passing under the gemelli, is applied to the bone itself in a special groove, perceptible on a well-marked skeleton. At this point it is much enlarged; its internal border is about four lines from the summit of the sciatic spine, the external about an inch; but, by recognizing this sciatic spine on the living subject, which is almost always possible, and pressing from about this spine to the extent of an inch across, we are sure to act on all the breadth of the nerve.

After half an hour's compression, I obtained in fact a kind of insensibility of the foot and leg to the knee; but the paralysis was not complete either as to sensibility or movement, and sharp pains in the knee obliged me to suspend the trial. I have not again tried it on other patients; but, even though the pathological state of this case may throw doubt on the value of this trial, the presence of the obturator nerve, which we do not know how to compress, always limits the effects of compression on the leg; and, everything considered, the circular constriction of the thigh by means of the twisted band (*le garrot*) seems to me much more simple in its application, and more sure in its results.

PART II.

GENERAL OPERATIONS.

CHAPTER I.

COMMON OPERATIONS, OR MINOR SURGERY.

MINOR SURGERY, besides the application of bandages, comprises four sorts of operations: *blood-letting—counter-irritation—vaccination—and acupuncture.*

SECTION I.—BLOOD-LETTING.

It comprises, for the capillary vessels, the application of *leeches*, *scarifications*, and *cupping*; for the veins, *bleeding* in different ways; for the arteries, *arteriotomy*.

1. *Leeches.*

There are several ways of applying them: causing them to fall off—making them disgorge—and arresting the hemorrhage.

Application of Leeches.—The part should be first washed, and then moistened with milk or blood, to induce the leeches to bite. It is advised, also, if they are lazy and idle, to roll them in a compress; and it has been said that, if their tails are cut off when they are attached, a continuous stream of blood may be obtained from the cut extremity. We have never seen this experiment succeed, the leech falling off at the same moment. There are numerous ways of application.

1. Take them, one by one, between the finger and thumb, naked or covered with a cloth, and apply their buccal extremity to the skin. This plan is long and fastidious, and is only suitable when the place of application is very circumscribed—to the lips or eyelids, for instance.*

2. If they are to be carried to a great depth—in the vagina, rectum, &c.—a speculum, shut on all sides but that on which the leeches should take, is first introduced; thus, for the neck of the uterus, the speculum is open at its extremity. If we wish to apply leeches to the prostate by the rectum (Amussat), the speculum should be open on its anterior aspect.

* Drutt says they should never be applied to the eyelids or prepuce, for fear of œdematous swelling, or even erysipelas.—Surgeon's Vade Mecum, p. 38.

3. If they are to be applied in a cavity where we cannot introduce the shut speculum, the mouth, for instance, each leech is put in a small tube of glass (Brunnerhausen), or in a tube of rolled pasteboard, and applied on the part. The leech may be pushed to the end of the tube with a pencil.

4. To apply leeches in great number, or on a large surface, put them into a common glass, and invert it on the skin. Often, many of the leeches stop at the bottom of the glass, in which case we are advised to apply something cold to it, in order to compel them to seek a warmer temperature. But, using a glass, the greatest part of the leeches attach themselves near one another and close to the border, so that you have a kind of circle of bites, which are thus more subject to suppurate. It is better then to place them in a cloth in the hollow of the hand reversed on the skin. The hand of the patient, or a bandage, or, better still, a glass, if the part will permit, applied on the compress, will hinder them from going off.

5. An instrument has been proposed consisting of a little capsule of silver wire, of a semi-oval shape, and bringing to mind well enough those little vases in which the eyelids are bathed. The free edge is formed of a silver band, flattened so as to apply exactly to the skin, with a ring at the top, on which we may press. The cavity is large enough to hold six or eight leeches. It is declared that even the least lively leeches bite immediately when applied with this instrument (Bourguery). The explanation given for it is not clear, but it deserves trial.*

To hasten their fall, we may prick them, cut off their tails, or put a bit of salt or tobacco near their heads. It is a surer method, when we wish to preserve the leech, to push its mouth from the place to which it is applied; but when the leech has penetrated to a cavity, as the rectum, vagina, nasal fossæ, or even stomach, injections of tobacco-smoke, decoction of tobacco, wine, solutions of nit. of potash, or kitchen salt, are recommended: this last is the most simple and preferable.

To make them disgorge.—Some take them by the tail, and squeeze their body between the finger and thumb from the tail to the head, thus making them vomit the blood swallowed. We never saw leeches survive this plan. If we have no need of them immediately, they may be left to digest at their ease in clear water; if we wish to re-apply them soon, they should be sprinkled with cinders—a sure way of making them disgorge. It is seldom that we do not lose some, but, in this way, most may be saved.

To stop the blood.†—Compression, with a compress and bandage, agaric, powdered fibrine. Cauterization with nit. of silver succeeds in ordinary cases; spider's-web appears to us preferable. If the

* Small punctures may be made with the point of a lancet, at which they will immediately take. They should never be pulled off forcibly.

† Pereira says, "I never failed with compression. Sometimes mere exposure to the air is sufficient; if not, roll a bit of lint into a fine cone, and introduce it by means of a needle or probe. Some recommend dipping the lint in tinct. ferri sesquichlor." P. 1362. See also note on Matico, p. 26.

blood does not stop, some advise placing a compress on the part, and putting on it a heated spatula, to cause the watery parts of the blood to evaporate and leave a coagulum. We have often succeeded by adding to cauterization by nitrate of silver pressure with the pulp of the finger for two or three minutes. When the hemorrhage resists, we must have recourse to more powerful methods.

1. Suture of the little wound with a very fine needle and silk is said to have been successfully tried.

2. Autenreith advises pushing small pellets of lint into the little wounds. This kind of bunging, according to him, succeeds very well.

3. M. Hatin points out a very simple way, which consists in pinching the skin surrounding the bite, and fastening it between the ends of a bit of wood partly split up; which ends, by their own spring, compress very exactly. The fixed forceps of Amussat would obtain the same end.

4. M. Ridolfo di Tacca, after many experiments, prefers the following plan. He applies a cupping-glass that includes all the bites: a coagulum immediately forms. After some minutes, the glass is removed, and the serum wiped away without touching the coagulum. The glass may be re-applied three or four times, until the blood is definitely stopped.

SECTION II.—SCARIFICATION AND PUNCTURE.

We thus name little wounds that ordinarily go no farther than the skin or subcutaneous cellular tissue. The first are incisions, the last only simple punctures.

I. PUNCTURES.—Made with a straight steel needle with a lance-shaped point, pushed in and withdrawn perpendicularly. It may be very well replaced by a sharp-pointed lancet. Recommended in certain cases of œdema, and recently in erysipelas, chemosis, &c.

II. SCARIFICATIONS.—We may draw along the skin one of the edges of a strong lancet inclined at an angle of 45° , which is made to cut as a bistoury. It is much more simple to use a scalpel or straight bistoury. M. Larrey prefers the razor, using its rounded extremity; he also invented a particular scarificator, with which we may well dispense. The German scarificator, which disengages at once sixteen or twenty lancet-blades by a trigger, and makes as many wounds in the twinkling of an eye, is to be preferred for timid persons. Care must be taken to apply it with sufficient force to extend the skin, and moderately enough to allow the blades to move freely. This instrument is only useful when we want to draw blood by the cupping-glasses. The bistoury or razor, which may replace it in all cases, is necessary when we would scarify a phlegmon, an inflamed stump (Larrey), or gangrenous parts.

SECTION III.—APPLICATION OF THE GLASSES.

I. *Dry Cupping*.—We may use small glasses drawn in at the opening, or, in place of them, common drinking-glasses. The object in all the modes of application is, to rarefy the air in the glass, and produce a vacuum, which the skin, swelling and rising into the glass, fills up. There are a number of plans.

1. A bit of paper, or a ball of cotton, may be placed in the glass, and set fire to, and the glass applied at the same instant. The air, at first rarefied by the heat, is condensed as soon as the fire goes out: the vacuum is made, and the skin rises into it. This plan often fails.

2. It is better to moisten the paper or cotton with eau de cologne or spirits of wine. A still more successful plan is, to spread a few shreds of tow in the bottom of the glass, moistening them with spirit, and then igniting them by a candle; immediately apply the glass.

3. The German barbers only plunge the glass for some moments in very hot water, and immediately apply it; on coming out of the water, the vessel is filled with vapour, which condenses on cooling.

4. The English prefer heating the air in the glass by means of a spirit-lamp. These two plans have the advantage of being less likely to burn the skin, but perhaps they require more apparatus.

5. To avoid the inconvenience of the preceding operations, it has been advised to guard the skin with a card,—a precaution that spoils the whole.

6. A more ingenious plan is, to place on the skin a card less than the opening of the glass, with two or three small bits of lighted taper on it; but this is too complicated.

7. Lastly, a glass with an exhauster has been invented; this instrument is certain, without inconvenience, and much more powerful than any of the others, but its costliness will prevent its coming into general use for a long time.

In every case, before applying the glass, a place should be chosen sufficiently flat and well shaved, and care should be taken to apply the glass perpendicularly, so that the external air may be perfectly excluded; but too much pressure must not be made (especially if the glasses are heated), on account of the pain. In these cases, also, a good recommendation is to have as little interval between the heating and application of the glass as possible. When the glass has had its effect, if we use one with an exhauster, we turn a cock which lets in the air; if the ordinary glass, we depress it on one side, and press with a finger or thumb on the skin at its edge on the other, so as to leave a little opening by which the external air may enter.

II. *Bloody Cupping*.—Apply the ordinary glasses; take them off after a minute's application, and scarify the red swollen skin, either with the German scarificator, or with the point of a lancet, razor, or bistoury. With these last, the scarifications are made of about half a line in depth, parallel to each other, at a distance of one-third of an inch, and crossed transversely or obliquely by other scarifications of like extent. All these cuts should be made very rapidly, and the

glass re-applied without losing a moment. The skin swells again, but this time blood escapes by all the cuts until the sucking action of the glass is exhausted. If an exhausting glass is used, another quantity of air is exhausted, and the suction renewed without moving the apparatus. With the ordinary glasses it is necessary to renew them. They are taken off as recommended, care being taken to remove with them the blood which is under them in a state of coagulum. The surface is then washed, and the glass re-applied, as often as is thought necessary, but not always on exactly the same spot lest it be too much contused.*

The operation finished, the wounds are wiped with care; then some cover them with simple dressing, others with sticking-plaster or olive oil, to prevent inflammation and suppuration. When the patient feels it smart, Mapleson prefers brandy and water, which, according to him, stops the bleeding and itching of the little wounds. Sarlandiere has united to the glass with exhauster a kind of scarificator, so that the instrument, once applied, need not be moved. This instrument, of which there are already many varieties, is called a *Bdellomètre*; it has too many complications to compensate its advantages; we only speak of it from memory.

SECTION IV.—OF BLEEDING, OR PHLEBOTOMY.

1. *Bleeding in the Arm.*

Surgical Anatomy.—In ordinary cases we find, at the bend of the arm, five principal veins that may be opened with the lancet. These, from without inwards, are: 1. *The Radial*; 2. *The Median Cephalic*; 3. *The Median Basilic*; 4. *The Median*; 5. *The Ulnar*; but in their number, size, and apparent depth, there is a host of anomalies.

The *Median Basilic* is generally the largest, the most superficial, and the most constant; it runs along the tendon of the biceps and the brachial artery, from which it is separated by the aponeurosis. Sometimes it passes parallel to the artery and immediately over it, but more often it crosses it very obliquely. It is also surrounded by branches of the internal cutaneous nerve. The proximity of the artery renders bleeding from this vein very dangerous; but it is worth noticing that it is the one generally opened.

With the other veins this danger does not exist; but they are more or less surrounded by nervous filaments, and the more so as they are more internal. The points most favourably situated for bleeding, are: 1. *The median cephalic*, at its upper part, where M. Lisfranc has never found nervous filaments; and at its inferior part, the forearm being pronated; then, in fact, if the muscles are well developed, the supinator longus covers both the tendon of the biceps and the musculo-cutaneous nerve; if the muscles are thin, we obtain the

* The glass should not be too much exhausted, or its pressure will prevent the flow of blood and cause an ecchymosis. The depth of the incisions should be regulated according to the thickness of the skin. If the incisions be too deep the fat will choke them.

same end by adding to the pronation a slight movement of flexion (Lisfranc).—2. *The radial*.—3. *The median*; but remember, when the median is situated in the interstice that separates the supinator longus from the pronator radii teres, it is accompanied by nervous filaments

Fig. 1.



Bend of the elbow in the right arm: *a*, basilic vein; *b*, median basilic; *c*, median cephalic; *d*, cephalic vein; *e*, median vein; *f*, radial vein; *g*, ulnar vein; *h*, internal cutaneous nerve; *i*, median nerve; *k*, humeral vein; *l*, brachial artery; *m*, radial artery; *n*, part of the biceps: a portion of the fascia has been removed to show it and the artery; *o*, the aponeurotic expansion of the tendon of the biceps.

whose lesion is inevitable; and that, in thin subjects, the radial artery is situated immediately beneath it; the aponeurosis also runs the risk of being wounded. This vein then ought only to be opened when it is situated on the inside or outside of the interstice. 4. *The ulnar and median basilic*. The ulnar is also so surrounded by nerves that M. Lisfranc prefers bleeding from the median basilic, which should always be opened, when possible, inside or outside the artery, and rather below than above it, the artery being situated more deep the farther it descends. Moreover, it may sometimes be made to lie more deeply, and change its most dangerous relations, by putting the forearm in a state of forced pronation.

Operation.—The apparatus necessary consists of a band of scarlet or brown cloth, a lancet, a basin to catch the blood, a compress, a roller, and some clean water.

Lancets were formerly divided according to the shape of their points, into the barley-corn, wheat, and serpent's-tongue lancet. Those of the first kind suffice. M. Capron, the cutler, in order to render them more solid, leaves a ridge in the middle,—an innovation, the utility of which has not been demonstrated. The

patient is bled sitting on a chair or bed, or lying down. It is done on the left arm with the left hand; but the most prudent way for a person who is not ambi-dexterous is never to bleed but on the right arm; or, if he does, to use his right hand, putting himself on the outside of the limb.

We commence by uncovering the arm as far as three or four fingers' breadth above the elbow. If the clothes, thus pushed up, compress the arm too much, they should be taken off, or the flow of blood may be hindered by this kind of constriction. Then make out the tendon of the biceps, and the artery on its inside, fix on the place to be punctured, and apply the ligature. Boyer advises to place it three or four fingers' breadths above. This distance is useless; in ordinary cases

one inch is enough; and, when the veins roll very much, it is better to bring it nearer, even to within four lines, or less, of the point to be punctured.

The bandage or tape is thus applied: The middle of it is placed flatly on the anterior surface of the arm, the end that hangs down on the inside a little longer than the other, as with it the bow is to be made. The ends are crossed behind the arm without twisting them or pinching the skin, and after a second turn a simple bow is made on the outside of the arm, the loop upwards, and the two ends hanging down. The constriction must be sufficient to cause the veins to swell without being enough to stop the course of the arterial blood and the pulse at the wrist.

Then place the patient's arm half flexed on the bed or his knees, and choose and prepare your lancet. Open it until the blade makes a right or slightly obtuse angle with the handle. Place the end of the handle in your mouth, its point towards the arm, so that the operating hand may have every facility of seizing the instrument by the heel. Then the surgeon takes the arm and extends it to the degree he wishes in pronation or supination; applies the hand of the patient against his breast, recognizes the vein again, and presses it slightly from below upwards to make the blood pass to the ligature, secures the vein with his thumb at the same distance as the ligature, and then pushes in his lancet. The lancet, held by the heel between the index and thumb, the other fingers leaning on the limb for support, is gently pushed into the vessel (movement of puncture), and, if the opening is not large enough, the hand is raised on the other side, and the instrument brought out cutting (movement of elevation). When the vein is deeply situated, the lancet must be pushed in almost perpendicularly, for fear of missing it; we may even mark the point where we recognized it, and are sure to find it, with the end of the nail;—here the movement of elevation is necessary. When the vein is superficial, puncture suffices; it is made slightly obliquely when the vein rolls; the size of the opening varies. As a general rule, it should rather be large than small, as we thus more surely escape thrombus.

It is recommended to open the large veins lengthwise, the small across, and the middling obliquely; we do not see the reasons. An incision more or less oblique is surer and more simple.

If at any time we are obliged to open a vein situated over the artery, the latter being endangered, it is better to make the incision parallel to it, longitudinal wounds of arteries being less dangerous than oblique or transverse.

When the vein is opened, the blood spouts out, and is caught in a basin. The quantity to be drawn varies according to the indication, from three oz. to two or four pounds; a more copious bleeding would cause anemia, or even sometimes dropsy. In order to encourage the flow of blood, a roll of bandage or any other substance is put in the hand of the patient for him to squeeze. The surgeon sustains the forearm with one hand, whilst with the other he watches that nothing arrests the flow of blood. When enough blood has been

drawn, place the thumb on the wound, or in thin subjects the skin may be drawn aside, so as to cover it; remove the ligature, and flex the arm; then clean with a wet linen the parts soiled by the blood. Apply the small compress to the wound, and secure it with a figure of 8 bandage. The ends may be tied or pinned, and the patient should be told to keep the arm semi-flexed for twenty-four hours, and especially to refrain from much movement or effort.

When the patient requires repeated bleedings, a little dressing should be put on the wound, to hinder it from uniting. To bleed the second time, put on the ligature again, and, when the veins seem distended, gently strike them near the former opening; or, placing your thumb on the wound, cause the blood to flow up by repeated frictions, and, when the vein is swollen and distended, suddenly remove the thumb. Some destroy the commencing adhesions of the little wound with a probe: but this may cause inflammation of the vein.

Of the Difficulties and Accidents of Bleeding.—I. When the vein cannot be seen, it may sometimes be felt with the finger. If this resource fails, we may cause it to appear by keeping on the bandage for half an hour or an hour, and making the patient frequently contract the muscles of the forearm (Lisfranc). It has also been advised to plunge the forearm in hot water, a plan sometimes advantageous, but which occasionally has the disadvantage of reddening the skin, and causing the cellular tissue to swell, and completely mask the vessel.

II. When the point where the vein is apparent is completely covered by cicatrices of former bleedings, it is recommended to open it immediately under them, because the cicatrices diminish the calibre of the vein (Boyer). This appears inexact to us, and we have always succeeded better by opening the vein through the cicatrices.

III. When the vein is situated immediately over the artery, we are advised to introduce the lancet almost horizontally, and enlarge the opening by elevation. This precaution does not give security enough. I had a lancet made for these cases, one of whose edges does not cut, and is nearer to the axis of the blade than the other. The vein is opened horizontally, so as to raise it on the cutting edge of the lancet; and it may be useful also to have the artery compressed superiorly at the moment of puncture.

IV. It is called a white bleeding (*“saignée blanche”*) when the vessel is not opened by the incision. If the vein appears at the bottom of the wound, it should be again attacked with the lancet; if it does not appear, we should open another.

V. The stream often stops all of a sudden after the first jet of blood is passed. This arises from different causes.

1. The ligature is too tight, and the arterial blood hindered from flowing. This is remedied by untying the ligature.

2. The clothes pushed back form a second ligature above the first. This obstacle must be removed.

3. The ligature is not tight enough, and the return of the blood not stopped in the vein;—it should be tightened.

4. The opening is too small ;—enlarge it.

5. The opening is stopped by a bit of fat ;—push it back, or cut it off with a scissors.

6. The parallelism of the wound in the skin with that in the vein is destroyed. This often happens because the vein is opened in a state of supination, and the arm is afterwards pronated ; or if it is flexed after having been extended ; or if the ligature is re-applied in a different way to the first, &c. The cause of the accident should be sought, the arm returned to its first position, and the skin moved about in different directions by the thumb, until the parallelism is restored.

The Polish barbers use a proceeding of the Middle Ages, which does not allow of the parallelism being destroyed ; it consists in making the patient firmly grasp a baton fixed perpendicularly in the ground.

7. Sometimes the jet of blood stops without any known cause : a few light taps with the end of the finger on the course of the vein, or friction from below upward, generally suffice to cause it to reappear.

8. If the vein opened is too small, frictions may be useful, or plunging the hand in hot water ; if these fail, you must open another.

VI. The patient may faint at the sight of the lancet, or in consequence of the incision, or during the flow of blood, or in consequence of a too copious bleeding. He may be restored by putting him on his back, sprinkling his face with cold water, making him smell vinegar or salts, &c. During this time, the thumb should be held on the wound. When there is reason to anticipate this, he should be bled lying down, with his head turned to the opposite side.

VII. Ecchymosis and thrombus have only one remedy ; that is, enlarging the wound when it is too small. They go away of themselves after the bleeding, the bandage being left on for some days. We may also dip the compress in some resolving liquid.

VIII. The more important accidents of bleeding are, the puncture of the artery, or of the nerves and phlebitis. Formerly, pricking the aponeurosis was added ; but in the present day it is thought insignificant. When the artery is pricked, we may stop the blood by forcibly flexing the forearm, putting it in a state of pronation, and applying a bit of money on the ordinary compress, over the wound. We succeeded once by these means.

2. *Bleeding in the Foot.*

The internal saphena vein may be opened in front of the internal malleolus, or the external saphena in front of the external malleolus ; but the latter is seldom large enough to be opened when the internal is not.

The patient, seated on a chair or the edge of his bed, first places his feet in hot water, until the veins are very apparent ; then the surgeon selects the foot, wipes it, rests it on his knee, protected by a napkin, and places the ligature two fingers' breadth above the

ankle, moderately tightening it, and securing it with a bow on the opposite side. He then explores the vein, puts the foot again in the hot water, prepares his lancet, retakes the foot, and opens the vessel. Care must be taken not to prick the bone, and break off the point of your lancet.

If the blood flows in a jet, it is caught in a basin, if it only dribbles slowly, the foot should be again put in the water. We then can only judge of the quantity by the time or redness of the water. When the bleeding is supposed to have been enough, the foot is taken out of the water and wiped, and a compress and figure of 8 bandage applied. Care must be taken lest the water be too hot, or the foot plunged in too deeply. It is said that the weight of the column of water tends to coagulate the blood, which then stops the mouth of the opening. On this account, the foot should be kept only just covered, and the wound be wiped from time to time; it is well also to make the patient move his toes.

3. *Bleeding from the Jugular.*

It is performed on the external jugular; the situation for opening has not been well fixed; if made too close to the clavicle, there would be a risk of the air introducing itself into the vein; if too high up, the vein is surrounded by nervous bands, which might be wounded; both inconveniences may be avoided by making the puncture an inch above the clavicle.

The patient being seated, his breast and shoulder covered with a napkin several times doubled, a thick compress is placed on the jugular near the clavicle, and on it the middle of a folded cravat, the ends of which are brought under the opposite axilla; an assistant holds these two ends, and keeps up sufficient pressure. The vein being thus distended, the left thumb is applied on the compress, the index-finger on the jugular itself, about an inch above, to steady the vessel and extend the skin; the lancet is plunged in deeply enough, making an opening larger than that in the arm.*

When the vein is very deep, or he fears piercing it through and through with the lancet, M. Magistel makes an incision in the skin about half an inch long with the bistoury; and, if the vein has not been opened in the same cut, he seizes it with a dissecting forceps, and divides it by a little longitudinal incision.

If the blood does not flow, cause the patient to perform the movement of mastication; if it dribbles, guide it into a basin by means of a little card-board gutter. The bleeding over, remove the ligature, and cover the wound with a bit of plaster or of taffeta; and, if that is not enough, add a compress and circular band moderately tight. Larrey wisely recommends, in order to prevent the entrance of the air, that the compression of the vein between the heart and wound should not be removed, until it is established on the wound itself.

* The lancet should be directed upwards and outwards across the fibres of the platisma, so as to prevent the wound being partially closed by the parallelism of its fibres.
—F. B.

Often we find some difficulty in stopping the blood ; in these cases, M. Magistel puts a stitch in the skin, supported by an ordinary bandage. This plan has always succeeded with him, without causing the least accident.

4. *Of some other Modes of Bleeding.*

When the veins at the bend of the elbow are not apparent, we open their branches in the forearm. The ancients opened even the veins of the hand and fingers. In like manner, when the saphena cannot be found, we open its branches in the foot.

It has been proposed to bleed from the frontal vein, the angular vein of the eye, the lingual, &c. M. Janson found it advantageous to open the veins coming immediately from the part inflamed. M. Lisfranc asks if, in case of necessity (no vein being apparent), we might not uncover the cephalic which constantly passes between the deltoid and great pectoral. An incision should be made about an inch in length, comprising the skin and cellular tissue. No one to my knowledge has been bold enough to try it.

When the methods of venesection we have described—leeches, cupping, and scarifications—fail, or are not sufficient, the simplest resource is Arteriotomy.

5. *Arteriotomy.*

Surgical Anatomy.—The temporal artery, situated in a fold of the fascia superficialis, divides into two branches, called the anterior and posterior, at a distance of about an inch and a quarter from the middle of the zygomatic arch, and two and a quarter from the auricular canal. It is covered by the skin, the subcutaneous cellular fatty tissue, and the auricularis anterior muscle; beneath it, is the temporal aponeurosis and temporal muscle, the fibres of which, at about an inch distance from the anterior part of the ear, are slightly oblique from above downwards, and from before backwards. Its anterior branch anastomoses with the frontal and superciliary arteries, and sends also some branches into the orbit through the foramina in the malar bone; in addition to these communications with the arterial system of the eye, the temporal has others with the vessels of the temporal and auricular region, and even with those that penetrate into the cranial cavity, by its anastomoses, with the posterior auricular and occipital; it is bordered by nervous bands coming principally from the facial nerve and from the auricular branch of the inferior maxillary. From these anatomical facts arise the following consequences:—

1. The temporal artery may be cut without the aponeurosis being touched.

2. Opened at some distance from the zygomatic arch, or as far as its bifurcation, it may give a large quantity of blood.

3. The disposition of the adipose cellular tissue cannot offer any obstacle to the flow of blood.

4. Section of the accompanying vein is of no importance.

5. The direction of the muscular fibres, at the point selected for bleeding from the temporal artery, is such, that we might even

divide the aponeurosis with the point of the bistoury without cutting them across.

Ordinary Proceeding (Boyer).—He only opened the anterior branch, which is easily traced under the skin of the forehead by the sight, or by feeling its pulsations. The patient seated, or lying down, the point to be opened is fixed upon, and marked with the nail, and the skin extended with the left thumb and index-finger; with the bistoury in the third position a short incision is made, more by pressing than sawing, so as to divide the artery completely across. The blood flows in jets or sometimes dribbles slowly. When it is thought fit to stop it, the artery is compressed near the wound, and the opening covered by three or four pyramidal compresses, which are supported by a bandage called the packer's knot; or by the simple circular bandage, which is left *in situ* eight or ten days, until the artery is obliterated.

Proceeding of Magistel.—The patient lying down, his head resting on the opposite temple, is retained by an assistant on the pillow covered with a thick cloth; a basin is held ready to receive the blood; a bit of card to serve as a gutter, if the blood dribbles: sponges, warm water, graduated compresses, and a bandage should be at hand. A small bistoury, with a narrow-pointed and curved blade, a small curved needle armed with waxed thread, forceps and scissors are the only instruments needed. If the hair is thick, it should be shaved, but generally it suffices to cut it with the scissors. If the patient is conscious, he should be told to shut his jaws forcibly, in which case the contraction of the temporal muscle raises the artery, and renders it more superficial; its position is ascertained with the fingers, and M. Magistel has remarked that it is easier to find it out, when we do not look for its pulsation until we have discovered it by the touch. The point where it beats most strongly being thus ascertained, the extent and direction of the incision are determined on; it may be marked with ink, but not with the nail, as that gives the patient a disagreeable sensation, and leaves only an untrue trace. The best place is on the trunk itself, an inch and a quarter in front of the opening of the ear, and two-thirds from the zygomatic arch. The left temporal is preferred, because the decubitus on the right side is less fatiguing, and after the bleeding he can repose better.

The left middle finger is placed a quarter of an inch above the situation of the incision, on the outside of the artery, the index serves to feel again its position and pulsation; the surgeon then takes his bistoury in the second position, or rather holds it as a lancet, and passes its point to the aponeurosis by a movement of puncture at about three lines distance from the finger that steadies the artery, and one line below it; in a second step, the point is carried under the artery obliquely from before backwards, and from below upwards; in the third (step of elevation), the artery and integuments are cut across at the same time; these three steps are united into one which is as rapid and as simple as bleeding in the arm.

If the middle finger was applied on the artery itself, it would tend to push it deeper; but placed above, and on the outside, it prevents

its deviation outwards during the incision, and perhaps also depresses the temporal aponeurosis. In opening the right temporal, the bistoury should be held in the left hand, unless the left middle finger be placed under the artery, and the puncture be made from above downwards. The incision may be made only 3 or 4 lines long, but we need never be afraid to make it large; if the artery is deeply situated, the bistoury must be plunged in deeply; the section of the aponeurosis incurs no great inconvenience. Lastly, when the incision commences below the artery, it should be directed obliquely from below upwards towards the hairy scalp.

When the artery has been opened, the patient turns his head and leans it on his occiput; a plug of lint is placed in the ear to prevent the blood from entering it; the blood is caught in a basin, and movements of mastication are recommended to facilitate its flow. When a large coagulum hinders the blood from flowing, it should be removed with a sponge and warm water, or the fingers. When enough blood has been taken, a finger is placed on the incision, and the temporal region washed; then the wound is brought together by two or three slips of sticking-plaster, and a small square compress, about four lines thick, is firmly maintained on it with a few turns of the bandage. This slight compression generally stops the bleeding. If the simple bandage is not sufficient, or if it is feared that it will loosen, or that the patient, in a fit of delirium, will take it off, Magistel makes a stitch with a curved needle. As the incision is oblique, this point of suture comprises the ends of the artery, or in all cases hinders the blood from flowing. Lastly, with docile patients, M. Magistel has been able to apply ligature or torsion of the ends of the artery.

Appreciation.—The method of Magistel is both more simple and safe. Very often, in only opening the anterior branch of the temporal, we do not obtain enough blood. Moreover, it is very seldom that this operation is followed by aneurism or hemorrhage, at least if the artery has been only partially divided.

SECTION V.—REVULSIVES AND BLISTERS.

(1.) *Of Sinapisms.*

A cataplasm, made with the farina of mustard and cold water, is applied to the naked skin; after, ordinarily, about an hour and a quarter, the skin becomes red, swollen, extended, hot, and painful, when the sinapism should be removed. Some have advised the addition of salt, onions, &c., to increase its force; but this is useless. Some mix up the mustard with vinegar; but the ancients even were convinced that the vinegar lessened the action of the mustard.

The Liquor of Pradier is a kind of sinapism.—It is spread on a large hot poultice of linseed, and applied on the naked leg or foot. It does not redden the skin, but produces an intolerable pain in the heel. It has produced marvellous effects in many cases of gout.—(Halle.)

(2.) *Of Blisters.*

A whole host of substances have been praised as vesicants. Now-a-days, we use only boiling water, or cantharides.

Boiling Water. Proceeding of M. Mayor.—A metallic hammer, with a large flattened head, is plunged in boiling water, and immediately applied on the naked skin. It raises a piece of skin of the size of the hammer; the nummular-shaped cautery may very well be used instead.

Proceeding of Carlisle.—A bit of cloth, doubled and wetted, is put on the skin, and the nummular cautery, heated to obscure redness, placed on it.

Cantharides. Common Method.—A layer of blistering-plaster is spread on a bit of linen or leather, bordered by a layer of diachylon, about three lines wide; the layer of plaster is sprinkled with cantharides' powder, dry, or moistened with vinegar. The skin being well shaved and rubbed with vinegar, the plaster is applied, and maintained by a bandage or straps; after twelve, eighteen, or twenty-four hours, the blister is formed, and the plaster should be removed. If we only want a passing blister, a small opening is made by which the serum may escape; the epidermis is left in its place, and covered with a bit of fine linen. If the blister is to suppurate, the epidermis should be removed by tearing or cutting with the scissors. The dressing does not belong to our work. In many hospitals, they use a layer of yeast, on which powder of cantharides is spread; others put it on a bit of dressing, &c. All these additions are superfluous; the powder by itself, spread on linen and moistened with vinegar, produces as sure results.

Proceeding of Bosquillon.—After six hours' application of the cantharides, the effect produced is examined. If the redness of the skin is well marked, the vesicant is removed, and a cataplasm of linseed meal, which raises the skin, put in its place. This plan is used with the intention of leaving the cantharides as short a time as possible in contact with the skin, so as to prevent its absorption and effects on the urinary organs.

(3.) *Issues.*

An issue is a small ulcer, kept open by putting a pea or peas into it. They may be made on all parts of the body, always avoiding the too close neighbourhood of bones, tendons, large vessels, nerves, muscles, &c. We choose the cellular interstices, where the skin is separated from the subjacent parts by a certain thickness. The choice situations are: in the arm, the hollow separating the inferior angle of the deltoid from the biceps, which is made very evident by flexing the forearm and contracting the biceps;—in the thigh at the inferior internal part above the knee;—in the depression between the vastus internus and sartorius;—in the leg, under the inside of the knee in the depression that separates the internal head of the gastrocnemius from the conjoined tendons of the sartorius, rectus internus, and semi-tendinosus.

First Method. The Bistoury.—A fold is made in the skin, and incised so as to leave a wound of from half to three-quarters of an inch in extent. A very firm roll of lint is put into the wound, and kept there by a bandage; three days afterwards, it is replaced by a pea. The simplest way is to put the pea in at once.

You may also make the wound with the scalpel—incising in the third position.

Second Method. Potassa.—The rules for its application have been given,* and we shall only say that the morsels should not be quite so large as a lentil; it is prudent to remove the dressing after six or eight hours, for fear that the caustic has gone too far. The eschar is cut across, and the four flaps dissected at their base with a forceps and scalpel, and a pea supported by a bit of plaster put in the middle.

Third Plan. The Blister.—A pea is fastened in the middle of the blister by means of a bit of diachylon. It hollows out a bed for itself; but this is a long and painful method, and not near so good as the two others.

(4.) *Of the Seton.*

The seton is a kind of issue made by piercing the skin in two corresponding points, and passing through them a *mèche* of cotton, or a bit of linen unravelled at the edges. It may be made in any region of the body where the skin can be raised in a fold. The nape of the neck is the chosen spot. The method of operating varies, some wishing to direct the seton from above downwards, others using particular instruments, &c.

Ordinary Proceeding.—The patient being seated, the surgeon stands behind, and on the right side. He pinches up a fold of skin, one end of which an assistant holds; he then passes a bistoury through the base of the fold, pushing it well through, and enlarging the opening in withdrawing the knife; especial care being taken to make both sides of the wound equal. Then, with a probe, he passes through the wound the *mèche*, previously spread with dressing. The skin may now be let go, and the probe withdrawn. A compress is then placed over it, in which the remainder of the *mèche* is folded, and the whole maintained by a circular bandage; the dressing should not be removed until the fourth day.

For the subsequent dressings, the portion of *mèche* in the wound is drawn through and cut off, its place being supplied by a bit of that in the compress. When one *mèche* is used up, another may be sewn or tied on to it, and we thus have no more need of the probe.

Proceeding of Boyer.—He employed a flattened needle, five or six lines wide, threaded with the *mèche*. The needle, in piercing the fold of the skin, draws in at the same time the *mèche*. This proceeding is more simple than the other, but does not sufficiently compensate for the requirement of a special instrument.

(5.) *Of the Moxa.*

The moxa is a slight eschar produced on the skin by the combustion of an inflammable substance. A host of substances have been recommended. Common wadding, lint, hemp, the pith of the sunflower (Percy), the down of the mugwort (Sarlandiere), phosphorus, camphor, essential oils, gunpowder, &c. We generally use carded cotton.

Ordinary Proceeding.—Some carded cotton is enveloped in a band of linen fastened by stitches, so as to form a cylinder of from three-quarters of an inch to two inches in diameter. The cotton must neither be too much nor too little compressed. It is then divided with a razor into several fragments of about three-quarters of an inch in length. The moxa thus prepared, and held in a common forceps, or in a bit of pasteboard pierced by a hole (Boyer), or a particular instrument for the purpose (Larrey), is lighted at one extremity, and the other applied on the skin, first moistened with saliva. The fire is made to burn better by blowing it through a tube or with a bellows; care must be taken to blow in such a way that the combustion is not more rapid in one part than another. We may prepare beforehand cylinders of cotton, surrounding them with linen. Gumming their external surface is quite sufficient.

Proceeding of Regnault. Moderated Moxa.—Small cylinders of cotton are burnt on a bit of thick wet cloth, with which the part is covered. They produce almost the same effect as the blister made by boiling water.—Recommended in hydrocephalus.

Proceeding used at Hôtel Dieu.—The cotton (after the advice of Percy) is first macerated in a strong solution of nitrate of potash. The moxa made of this cotton burns of itself without blowing, and the result is quite as satisfactory as by any other method.

SECTION VI.—VACCINATION.

Vaccination comprises the modes of collecting the vaccine, and of inoculating.

Preservation of the Vaccine. In a Tube.—The cellules of the pustule are pierced with a lancet, and the drop of liquid which comes out is allowed to harden in the air; it is then put into a glass tube or quill, hermetically sealed with wax. The vaccine may be thus preserved for months.

M. Fiard.—M. Fiard uses small capillary tubes, about two inches and a half long, open at one end, and terminated at the other by a small globe like that of a thermometer glass. On putting this globe into the mouth, the air it contains becomes rarefied by the warmth, and a portion is driven out; if the open extremity be now applied to the opened pustule, and the globe be allowed to cool, the air contracts, and leaves a vacuum which is filled up by the liquid of the pustule. When it is considered full enough, the end of the tube is closed by presenting its extremity to the flame of a spirit-lamp. The

matter is thus preserved liquid, limpid, and pure, and at all events, as long as by any other method.

In order to charge the lancet, the end of the tube is broken off, and the globe warmed between the fingers; the expanded air drives out the liquid, which should be caught on the lancet without the admixture of any other liquid. We may add that, to make the matter return in the tube, it should be held between the fingers, and the globe cooled, and *vice versâ*. This plan is very simple, and seems to us eminently superior to all the others.

2. *Between two Plates of Glass*.—The pustule being opened, a plate of glass is presented to the globule of matter that escapes; if this drop is too small, another may be added. The two plates are applied one on the other, and luted with sealing-wax or size, or simply covered with a bit of sheet-lead to keep them from the air and light.

3. *On the Lancet*.—The pustule is pricked with the lancet, which is then touched on each side, so as to charge them both, and the liquid left to dry in the air. One pustule furnishes enough vaccine for six or ten lancets. Each lancet is sufficiently charged for two punctures, but the vaccine does not last long. The best time for collecting the vaccine is from the sixth to the seventh day. After that, it loses its energy.

Inoculation with the Vaccine.—From all the proceedings described, we shall choose the simplest and most sure—the one adopted at the Royal Academy of Medicine. The point of a lancet must first be charged with the vaccine liquid; if we vaccinate from arm to arm, at each puncture the lancet should be replaced in the pustule to charge it afresh. If we use dried vaccine, it must be first moistened with a drop of water or saliva.

Generally, three punctures are made in each arm, on the upper and outer part, and at a distance of an inch from one another; sometimes they are arranged in a vertical line, sometimes in a triangle, but this is a matter of no importance.

The point of the lancet is presented almost horizontally to the skin, and pushed under the epidermis about half a line; a slight drop of blood usually appears, but is of no consequence; after leaving the instrument three or four seconds in this position, it is turned in the wound on one side and on the other, so as to separate the edges of the wound and allow the vaccine to enter. The faces of the lancet should be wiped also against these edges. Each puncture thus requires seven or eight seconds.

The wound is then left to dry in the air; and care should be taken that too rough or too tight clothes do not rub it.

SECTION VII.—ACUPUNCTURE.

I. *Acupuncture*.—The acupuncture needle, generally very fine and of about two inches in length, is composed of a cylindrical shank, with a sharp conical point at one end, and a little steel handle at the other, four or five lines long. When the needle is to be used for

electro-puncture, a small ring may be added to the handle. There are three ways of introducing it.

1. It is pressed perpendicularly on the skin, the handle being rotated between the finger and thumb. This rotation, combined with moderate pressure, suffices to introduce it as far as desired; the shaft of the needle should be supported with the left hand.

2. The needle is held perpendicularly with the left hand, and the handle struck repeatedly with a small mallet. This plan is more rapid and not more painful than the last.

3. The needle may be introduced rapidly, and at one effort. This is preferable to the other two, on account of its promptness and simplicity.

The needle is withdrawn by pressing the two fingers on the skin where it was inserted, and dragging it out perpendicularly.

II. *Electro-Puncture*.—The needles having been introduced as we have directed, a Leyden jar is repeatedly discharged on each of them, or they are put in connection with the two poles of a galvanic pile by means of metallic wires, or electricity is communicated to them in some other way. M. Coster applies electricity without needles. Having made frictions of pure iodine in doses of half a grain on one side of a goitre, he passed a galvanic current across it by putting its two sides in connection with the two poles of a voltaic pile, and thus obtained complete success. He supposes that in this way he increased the absorption of the iodine.

CHAPTER II.

OPERATIONS PERFORMED ON THE EPIDERMIS AND ITS DEPENDENCIES, OR THE ART OF PEDICURE.

I.—CORNES.

Anatomy of the Epidermis.—The corn is an excrescence in the shape of a *nail*, the point of which is buried in the deep layer of the epidermis; sometimes even it passes beyond the dermis as far as the periosteum or articular capsule (Dudan). Excepting in these cases, which are rare, if the skin supporting the corn be macerated, it becomes detached of itself, and the neighbouring epidermis seems healthy and normal. The corn seems formed of concrete mucus, which becomes easily softened by contact with fluids. We do not find in it either nerves or vessels: some have a black point in the centre; and Laforest has seen under some of them a serous cyst or bloody tumour. There are three ways of operating.

1. *Excision*.—The corn and epidermis having been softened by a pediluvium, the upper and central part of the corn should be gradually shaved away with a scalpel until the pain and rosy colour tell us that we must not excavate further. We then excise the borders in

the same way, taking care not to wound the skin. Almost always the edge of the scalpel becomes covered with a viscous coating, which prevents it from cutting; this is removed by dipping the knife in warm water or oil, and wiping it with fine linen. If we perceive in the centre one or more black or white spots, we should endeavour to remove them with the point of the knife. Corns of this kind are more deep than others. If a cyst or bloody tumour is met with, it should be freely opened.

2. *Cauterization*.—Some have advised cauterizing the corn with a bit of burning wood (Avicenna), or with a drop of melted sulphur (G. de Chauliac). Rousselot mentions the following plan, with which Laforest succeeded. A small pad was made with spider's web, and placed on the corn; it was then lighted, and left to burn as a moxa.

3. *Extirpation. First Proceeding*.—If the corn is recent and superficial, after half an hour's pediluvium it may be torn out with the nails or the blade of a knife.

Second Proceeding (Dudan).—The feet should be carefully washed over night, or some hours before the operation; the patient on the left side of the window, a little facing the light,—seated, for the corns on the sole of the foot, on a common chair—for the others, on a high chair or table; the operator, seated on the right, his right foot on a stool to raise his knee, fixes the patient's foot on this knee. When the corn is very thick, it should first be thinned with a scalpel; then it is circumscribed by scratching round it with the point of a square scraper, and, after it is a little separated from the epidermis, its border should be seized with a dissecting forceps, and it should be gradually separated with round or flattened sharp-pointed stilets. In order to prevent pain and flow of blood, we must not quit the limit of the corn and epidermis: we may have recourse to a glass in order to see better, if necessary; and, if the operation is done by the light of a candle, care should be taken to concentrate its rays by means of a round bottle filled with water. When the root of the corn is too deep, we must defer the termination of the operation for eight days. The extraction finished, the foot should be put in water for about a quarter of an hour; the dependencies of the corn swell and form a white spongy projection, which should be carefully wiped, and torn with the knife. If there remains any pain, and we see a brown spot at the bottom of the excavation, it should be touched with the argent. nitras.

Appreciation.—Excision is the easiest, cauterization more sure, but more painful; extirpation is preferable when a radical cure is looked for, but it is only suitable for corns situated between the toes.

II.—THE BUNION

Is a simple thickening of the epidermis: the *bunion* has a large base, and several layers of epidermis (like the layers of an onion) adhering to the skin in several points. They may be filed down with pumice-stone or a fine file, or extracted, but are generally excised.

III.—WARTS.

Anatomy.—If a wart be cut through vertically, we find it to be formed: 1. By the thickened epidermis. 2. By the chorion also thickened, and sending into the thickness of the epidermis prolongations called the roots of the wart. Sometimes these roots show themselves outside by a cleft appearance. Often we find in warts black points. M. Cruveilhier once saw blood-vessels well developed, and following in a striated manner the prolongations of the dermis.

Five Methods of Operation.

1. *Ligature.*—When the wart has a narrow pedicle, we tie it tightly with a bit of silk, horse-hair, or simply wax thread.

2. *Cauterization.*—The small cauteries used in stopping the teeth are successfully employed; or a drop of nitric acid may be put on it with a pen, and repeated twice a day; or it may be touched with nitrate of silver. Lastly, in some large warts developed on the sole of the foot, which hinder walking, the caustic potash is applied as if to form an issue (Dudan).

3. *Extraction.*—They may be sucked with the lips, so as to render them sufficiently supple and prominent to be extracted with the teeth (Galen).

4. *Excision* consists in removing all the prominent portions, layer by layer, shaving them with a bistoury. The blood may be stopped with a bit of spider's web.

5. *Extirpation.*—The wart is circumscribed with the point of the bistoury, by two small semi-elliptical incisions. The extirpation is finished with the bistoury or curved scissors.

Appreciation.—The ligature has its special indication; the extraction is long, and not sure; extirpation, too painful; cauterization by nitric acid generally preferred: it causes sharp pain, especially in delicate parts; the face, for instance. For ordinary warts, we prefer the nitrate of silver combined with excision. We may also, by excising the cauterized layers after two or three days, cure the wart without loss of blood, and almost without pain.

IV.—FALSE BURSEÆ.

They may be opened with the lancet, when the epidermis is very thin; when it is hard and thick, it should be incised with the straight bistoury, and a sufficient flap removed with the scissors.

V.—COLLECTION OF PUS UNDER THE NAIL.

The nail is thinned by scraping with a bit of window-glass, until it may be opened easily with the point of an instrument. In the same way we extract foreign bodies, whether developed under the nail—as certain corns, for instance (Laforest)—or come from without, as a splinter or thorn. Simple ecchymoses are left to absorption.

VI.—ABNORMAL INCREASE OF THE NAIL.

We sometimes see the nail of the first or second toe acquire an enormous volume, and cause a projection equal in size to a small nut (Laforest). Rouhault saw one four inches long, and of proportionate thickness. The projection may be filed down, or cut off with a fine watchmakers' saw; Dupuytren removed it with the cutting pincers.

VII.—NAIL GROWING INTO THE FLESH.

Anatomy.—Either the nail deviates from its proper direction and grows into the flesh, sometimes ulcerating the neighbouring toe; or the flesh is pressed against the nail by tight shoes. In each case, after some time, the nail is more curved on one side than the other, and the portion that is buried in the flesh becomes detached from the subjacent parts. There are many ways of operating.

1. *Narrowing the Nail.*—This method tends to correct the too great width of the nail—the presumed cause of all the disorders.

Proceeding of Dionis.—The middle of the nail is scraped through, so as to divide it into two parts; which are brought one against the other by a bit of lint put between the portion buried in the flesh and the flesh itself. This operation should be recommenced every month.

M. Faye improved this proceeding. He pierces a small hole in the free border of each half, and passes through the holes a metallic thread, which he tightens by twisting the ends as a ligature.

Proceeding of M. Guilmot.—The author commences by saying "that it is always the external border of the nail that enters;" and that the upper leather, pressing against the internal border of the nail, and especially against its internal angle, drives the nail outwards, and causes its outer edge to be buried in the flesh. It suffices, then, to keep the internal edge of the nail always cut, in the direction of a diagonal line drawn from the middle of its anterior to the middle of its internal edge, or as far back as possible. The boot should be long, and tight on the metatarsus, so that the great toe may not reach to the bottom. The author appears to have only made trial on himself, cutting the nail in this manner every eight days; but, after eight or nine months of this treatment, having omitted to cut them for a month, the pain returned.

2. *Re-curving of the Nail.*—Desault imagined that the improper curve of the nail was the essential affection.

Proceeding of Desault.—He used a bit of tin, one inch and one-third long and one-third of an inch broad, the extremity of which, slightly curved, he introduced between the flesh and the nail. With this he raised the latter, and depressed the former, covered beforehand with a bit of dressing; then re-curving the bit of tin from within outwards, so that it should exactly embrace the flesh, he made it fast in this position by a bandage round the great toe.

In a case reported by Bichat, the treatment was accompanied by acute pain, and only terminated at the end of two months.

We shall merely mention the methods of Richerand, who used a bit of lead ; of Dudan, who proposed silver, &c.

3. *Extraction of the buried portion of the Nail. Proceeding of Fabricius d'Aquapendente.*—He first isolated the nail from the flesh with a little lint ; then, with the scissors, he cut the nail to where it adhered to the flesh, and, seizing it with the pincers, he slightly separated it (but without violence) from the rest of the nail. This he repeated the next and following days, until it was completely taken away.

Dionis performed the operation at once with the bistoury and scissors, and without lint, having first of all bathed the patient's feet to soften the nail. He afterwards cauterized the flesh if it appeared necessary.

Proceeding of Dupuytren.—He passed under the middle of the free edge of the nail one branch of a pair of scissors with a fine point, pushing it rapidly up to the root of the nail, and dividing it into two almost equal portions ; then he seized the affected portion with a forceps, and tore it off by rolling it on itself from within outwards.

M. Larrey adds to this manœuvre the excision of the flesh on the outside, so as not to leave the least part of the matrix of the nail. He allows the wound to bleed for a few minutes, and then passes over it a heated iron. The dressing should not be removed before the fifteenth day ; and some dressings, followed by the application of the argent. nit. cause the wound to be covered with a good cicatrix.

4. *Removal of the Flesh.*—Long ago used by the Arabs, described by A. Paré, renewed by MM. Lisfranc, Brachet, and Levrat Perrotton.

Proceeding of M. Lisfranc.—He pushes the point of a straight bistoury from within outwards, immediately between the nail and the flesh that covers it, so as to comprise all that passes its edge. The flap is pushed from the side of the end of the toe ; then by raising it, and turning the bistoury, he detaches it at its base.

M. Lisfranc especially insists on these two following points, as those on which depends the success of the operation :—

1. The ablation of the tissues must extend from the end of the toe to two lines from the point where the skin ceases to cover the posterior part of the nail. Without this condition, the cicatrix draws the tissues from behind forwards, and, when it is formed, brings them again against the nail, which can enter them afresh.

2. The wound is made in a great measure on the very abundant cellular tissue which constitutes the fatty cushion with which the toes are padded. This wound has a tendency to vegetate, so that, if the granulations be not kept down by caustic, the new growth will become as large as the part removed, and necessitate a fresh ablation. On this account we should frequently apply the nitrate of silver, beginning even from the second or third day after the operation. It retards the healing ; but the cicatrix is firm, and makes no projection, so that the nail grows over it instead of into it.

Proceeding of M. Levrat Perroton.—He prefers the caustic potash to the bistoury. He recounts already ten successful cases by this plan, for which also M. Brachet has abandoned the bistoury.

Appreciation.—None of these proceedings promise a complete and definite cure, because the development of the nail is owing to the matrix, which always reproduces it the same; and, as palliatives, they are all too painful or too tedious. For many years, the pathological fact that the buried portion neither adheres above nor below, has made me adopt the following proceeding:—

All the buried portion of the nail, as far as where it comes out of the flesh, is cautiously divided with a scissors or the point of a bistoury. It is then seized with the forceps, and pulled so as to tear it out. (We know that the nails tear easily across.) This operation is performed without pain, and without the loss of a drop of blood. A bit of lint is placed under the flesh, and immediately afterwards the patient may walk or run without danger. This operation must be repeated every three months.

VIII.—DESTRUCTION OF THE MATRIX.

Advised by some when the nail enters the flesh; by Dupuytren for those cases only in which the matrix is diseased. It has been attempted by cauterization after the removal of the nail; by long-continued pressure, so as to cause its atrophy and cicatrization (Boyer); and by extirpation with the bistoury, which is done in two ways. We shall describe the total extirpation. It is easy to apply the same method to the extirpation of a portion only.

Proceeding of Dupuytren.—The foot being grasped in the left hand, a deep and semicircular incision is made with the straight bistoury, about one-fourth of an inch above the apparent origin of the nail, so as to cut round the matrix and nail; then an assistant supports the toe, and the flap is raised from behind forwards with a forceps, and dissected off, all the skin that covers the nail at its root being detached with it.

Proceeding of M. Baudens.—The skin of the toe is cut at the point indicated, and, with the bistoury firmly grasped in the hand, the matrix and nail are both removed together at one cut, like a chip of wood.

This second proceeding is doubtless more expeditious than the first, though perhaps less sure; but after each we must carefully extirpate all the white and fibrous parts in the bottom or angles of the wound. We have seen these little bits, when neglected, reproduce the nail and disorder.

The operation may be confined to the matrix alone; the nail will always fall off of itself, and never be reproduced.

IX.—EXOSTOSIS OF THE LAST PHALANX OF THE GREAT TOE.

This is often confounded with the diseased nail. It springs from the superior part of the last phalanx, raises and deforms the nail more

or less, and renders walking painful. It is pyramidal, generally soft and spongy inside, and covered with a thin compact layer.

Proceeding of Dupuytren.—A semicircular incision surrounding the tumour is made on each side of it with a bistoury, and its base is cut through with the same instrument, or with the gouge and mallet, if necessary. The nail is left, and especially its matrix, unless there is some special indication.*

CHAPTER III.

OPERATIONS ON THE TEETH.

WE shall treat, successively, of the operations for cleaning, filing, cauterizing, stopping, extracting, and luxating teeth, and lastly of replacing them. The method of fabricating, &c., artificial teeth does not come under the head of operative surgery; so we shall not speak of it.

I.—OF THE CLEANING OF TEETH.

Instruments.—Small rasps, with a cutting or chisel-shaped edge, square scrapers, &c., are used. We may restrict ourselves to the following: 1. A carp's-tongue rasp, or scraper—a kind of file, sharp at both sides. 2. Scissors-shaped rasp. 3. The spoon-shaped rasp. 4. A square bodkin, sloped off at one point only. 5. A square rasp, chisel-edged, bent at a right angle; and a small mirror, one inch wide by four long, with no other mounting than a very thin back.

Operation.—The patient should be seated with his head resting on the back cushion of an arm-chair, and a napkin on his shoulder to wipe the instruments on; a basin and some water to wash out his mouth should be close at hand. The operator stands before him, the fingers of the left hand serving to separate the lips, steady the head, or gently turn it to either side, without at all leaning the hand on his face.

We begin with the upper jaw. With the carp's-tongue rasp held as a penknife (the upper lip being raised, and the thumb sustaining each tooth whilst it is being cleaned), we remove the tartar from the front and right side of each incisor tooth; for the left side of each tooth, we hold the instrument as a pen in writing, and take our point of support, with the little and ring-fingers on the neighbouring teeth. The scissors-shaped rasp serves for cleaning the external face of the molars, either acting from above downwards, or before backwards; their internal surface is cleaned with the bent rasp. On the right

* I saw Velpeau remove an exostosis of the great toe, with a large and very strong scalpel, cutting it off in one stroke of the knife, as one would cut a knot off a stick.
—F. B.

side, we take our point of support on the thumb of the left hand ; for the left side, and for front teeth, the palm of the hand is applied on the chin covered with a cloth.

For the incisors of the lower jaw, the operator stands behind the patient, and uses the carp's-tongue rasp ; after having removed all he can, he returns in front, pulls down the lip with the thumb covered by a cloth, supports the teeth if loose with the left index-finger, and uses the rasp from below upwards.

The molars of the lower are cleaned in the same way as those of the upper jaw. The instruments are also the same for the inner side of all the teeth. The bodkin has two uses ; it serves to remove all the tartar from between the teeth ; when the layer of tartar is very thick, we begin by passing its point through it as far as the tooth, and by rotating the instrument split the tartar ; the chisel-shaped rasp is also of great service for this purpose.

The spoon-shaped rasp serves to detach the tartar from the neck of the tooth, passing along the border of the gum, without injuring it.

General Rules.—1. Care must be taken to support loose teeth, and to cut the tartar in pieces on the tooth without any shock, always being master of your instrument.

2. The instruments should always act from the neck to the edge of the tooth, so as not to wound the gum.

3. We must not expect to render the canines as white as the incisors, they being naturally more yellow.

4. The same whiteness and brilliancy cannot be obtained in every individual ; we should then be content with removing the tartar, without touching the spots in the enamel, which are indelible.

5. When we find the tissue of the tooth softened, or deprived of its enamel, we must proceed with caution : it is often better to leave a little tartar on it.

6. We should never divide the gums nor separate them from the teeth.

The greatest part of the operation being finished, we pass a quill toothpick between the teeth, rub them with a bit of cotton moistened and dipped into some dentifrice, and examine with the mirror inside to see that nothing has been left.

When the tartar is difficult to remove with the rasp, whether because it is near the neck, or that it occupies the indentations of the teeth, we may use a bit of pointed wood, dipped in a mixture of acid hydrochlor. 3i , water 3v . The tartar, rubbed with this point, is soon decomposed, and the parts should be immediately moistened with water, to wash away the acid, and prevent its acting too strongly on the tooth.

II.—OF FILING TEETH.

Instruments.—We use for this purpose fine goldsmith's files, some worked on one side only, others on both ; small fine saws we have found sometimes very useful in certain cases. The files must be cut

uniform and without fault, in order to escape shocks. For the teeth at the back of the mouth, we should have stout files in a handle; for the others, it is better to dispense with the handle; the file is firmer, and less subject to break.

Operation.—The patient should be seated, the operator standing. Warm water should be ready, to dip the files in, cold water causing a disagreeable sensation. The operator stands, according to necessity, sometimes in front, sometimes behind; he should separate the lips with the left hand, which furnishes a resting-place for the right, and use the instrument very evenly, avoiding quick or rough movements; if it hitches or catches, he must stop, and try to disengage it gently; the least effort risks breaking the tooth or instrument. These are the rules to be followed, whether in filing the teeth to destroy a caries, or rough edges, or to shorten a tooth that is too long.

1. If the caries is slight, it should be completely removed; if deep, we should content ourselves with separating the diseased from the neighbouring teeth.

2. When we file a tooth on its side, a portion at the neck should be left untouched, so as to prevent the neighbouring teeth from closing together and approaching it.

3. If we act on the incisor teeth, the file should be directed as obliquely as possible, so as to spare their anterior surface.

4. If the two teeth are carious, we use a double file; if only one, we use the file cut on but one side.

5. If we have to remove roughnesses and asperities, or to shorten a tooth, the fine saw is better, and does it more quickly than the file; in this case, if we cannot direct the blade of the saw transversely, we direct it obliquely in many directions, so as to cut in several fragments what we cannot remove all at once.

6. When the portion to be removed is considerable, it should be divided by angles or eminences, instead of filing it down uniformly; this plan is more speedy.

7. When a tooth is too long, it is prudent not to remove more than half a line at a time, and not to recommence till some months after; in this way, we do not remove too much of the tooth at once, and the filed tooth becomes by degrees accustomed to impression, and there is less chance of caries.

8. Sometimes, also, a rather long operation causes a general irritation, noises in the head, and a kind of nervous irritability; in this case, we should postpone the operation, and resume it some days after.

9. Before filing very carious teeth, especially molars that have nothing but their enamel left, we should cut them with a scissors or good forceps.

III.—BRUISING THE DENTAL PULP.

A steel sound, curved, and very pointed, is used. Begin by cleaning out the cavity hollowed by the caries, carefully scraping its parietes. Then endeavour to introduce the point of the sound into the

orifice of the roots, and turn the instrument so as to completely crush the nerve. If the sound is too large, use a needle of iron, steel, or any other metal, sufficiently fine to enter as far as is necessary; if the cavity will not admit these, a strong pig's bristle, with which the nerve should be pushed and pressed until it gives no further pain; this bruising is very painful, and rarely efficacious: cauterization is preferred.

IV.—OF CAUTERIZATION.

First Proceeding.—Heat in the candle a finely-pointed metallic sound, or simply the end of a knitting-needle, filed to the size of the carious hole, and mounted in a porte-crayon. In order to succeed in the operation, the patient must be courageous, and the carious hole so situated that the instrument may be quickly introduced.

Second Proceeding.—An Italian dentist has proposed to direct against the pulp a jet of ignited hydrogen gas, by means of a bladder and the canula of Anel's syringe.

Third Proceeding.—The cavity of the carious tooth is filled with a small bit of cotton, steeped in alcohol, or, to act more energetically, nitric or muriatic acid, either pure or diluted; this application should be repeated several times.

It has also been advised to pass into the cavity a small fragment of caustic potash, or a mixture of equal parts of nitrate of silver and acetate of lead; the cavity should be covered with a pellet of cotton until the effect is produced.

Others introduce directly a drop of liquid acid on the end of a needle or the nib of a pen. But we cannot be sufficiently sure as to the quantity of caustic employed, nor of the manner of introducing it; whence the following proceeding:—

Fourth Proceeding (Turck, of Nancy).—The instrument M. Turck uses is a tube of very thin glass, about three-quarters of an inch in diameter, globulated at one extremity, and drawn out to a capillary tube at the other, curved to the required degree; by holding the tube and globe in the hand, the contained air becomes sufficiently rarefied to expel a small quantity. If the capillary extremity be then plunged in the acid, a quantity more or less considerable enters the tube as it cools. Nothing is easier than to graduate this quantity. The instrument thus charged is carried to the required spot, and, by again heating it, the liquid is driven out.

Appreciation.—Cauterization is a painful operation, liable to bring on inflammation of the alveolar periosteum; we should not, then, employ it on teeth too sensible to cold and heat. This sensibility is sought to be checked by the application of different tinctures (Gariot). But another more important objection is, that it seldom succeeds, as the pulp grows again from day to day as it is cauterized (Laforgue).

If we resort to cauterization, it is evident that the actual cautery is the best for the teeth of the upper jaw; for the others, the plan of M. Turck seems to us the most sure and ingenious.

V.—OF STOPPING TEETH.

The teeth are stopped in two ways, either with metallic leaves or by means of a fusible metal, melted in grains.

FIRST METHOD. Common Proceeding.—The necessary instruments are, a curved sound for cleaning out the hollow, a pointed sound, and a sharp one, a polisher, some carded cotton, and leaves of lead, gold, or silver; these may be had at the gold-beaters'. They should be a little thicker than those used for gilding, and the gold should have been refined; without this precaution, in stopping, it may fall into powder (Laforgue).

We commence by cleaning out the hollow, and removing all moisture with little bits of cotton; if the cavity seems smooth, we make it rough with a scraper, so that it may better retain the metal; let the patient keep his mouth open lest the saliva again moisten the tooth. Make a small ball, three times the size of the hollow, by rolling the leaves between the fingers; with the pointed sound push it in, so as to cause it to well fill the interior parts first, pressing it down to make it stick; the second sound serves to make stronger compression. When the cavity is well filled, if there remains any outside, take it off with the scraper, and polish with the burnisher; this latter should be warmed if the leaves are of lead. The ball should be made rather too large than too small, as what is added never well unites with the first. We should never stop painful teeth, and if much pain comes on after the operation, the stopping should be removed, and the pain sought to be calmed.

Proceeding of M. Delabarre.—In order to put the nerve out of the way of pressure and pain, he places a small concave plate of gold over the nerve at the bottom of the hollow, and stops above it. This plan would only do in very hollow teeth.

SECOND METHOD.—We may employ the same instruments, only, as they are to be applied hot, they should bear an expansion near the point, capable of retaining the necessary caloric. The tooth being clean and dried, we place in its cavity or orifice a grain of fusible metal, by means of a forceps, or by pushing into it the point of the sound; the hot end of the cautery, heated in the candle, is applied on it, the metal melts and fills the cavity; the superfluous portion may be removed with the cautery, burnisher, or scraper. This plan is preferable to the other for the lower jaw; it is often impossible to apply it on the upper. We may join to it the plan of M. Delabarre.

VI.—OF EXTRACTION.

Instruments.—Amongst the multitude of instruments invented for this operation, some are absolutely bad, and ought to be rejected, such are the “pied du biche,” and the “pelican;” others superfluous, or of little use, as the modifications of the key and pincers, or forceps. We shall describe five, which may advantageously replace all the others.

1. *The Gum Lancet*.—An instrument terminated by a small blade, with a blunt and concave edge serving to separate the adherent gum from the tooth.

2. *The Key of Garenggeot, modified*, is composed of a transverse handle solidly fixed to a shank of steel twice bent, so as not to touch the front teeth, when put far back into the mouth, and of a cushion or quadrilateral plate, placed on the side, and at the end of the shank. The claw is fixed to it by a movable screw with a flattened head; it should be curved so that its extremity alone touch the tooth, for, if it touch the crown of the tooth, it is very apt to break it. The shape used by M. Delabarre seems preferable. We should have two or three of different size, one middling, terminated by a cutting edge, and one Z-shaped, for the last molars.

3. *The "Tirtoir."*—Made on the principle of the key, with this difference, that the handle is in a line with the shank, and the bolster and claw are directly at the extremity of the shank.

4. *The "Davier."*—A sort of forceps, straight or curved, and of various sizes; one with middle-sized teeth seems to us enough, because this instrument should only serve for extracting teeth already broken and loosened. It should be chosen curved, and with the teeth separating laterally rather than from above downward.

5. *The Lever*—Is composed of a slightly curved shank, terminated by a sort of quadrangular pyramid, with two sides much wider than the others. Instead of terminating in a point, we prefer having almost a cutting border, so that the instrument is not unlike a turnscrew; the handle may be transversal, or in the direction of the shank.

Method of Operating.—The patient should be seated opposite the light, on a chair with a back or cushion to it, for him to lean his head upon. If we have not this, he may be placed against an assistant, a wall, or the knee of the operator. The operator should stand in front or on one side, for the teeth of the lower jaw; for the upper jaw, it is better that he should be behind, in which case the patient may sit on a low footstool or on the ground, with his head back and leaning against the operator. In case of necessity, we may operate on a patient in bed.

First find out the affected tooth, and see if it be loose or firm. If it be loosened, and the gum very adherent, it is a fit case for lancing. In general, this is unnecessary; it only prolongs the operation, and does not always prevent the gum being torn with the tooth.

1. *With the Key*.—After having armed the key with the suitable claw, and fixed on the points on which it should act, introduce the instrument with the right hand, the index-finger along the shank, the medius holding up the claw, or *vice versâ*; then, with the left finger, place the claw on the tooth below the crown, as near as possible to the alveolar process, taking care that it does not at all touch the crown of the tooth, and take your fixed point on the other side of the gum with the bolster. The claw must fall perpendicularly, the least obliquity risks breaking the crown. The instrument being well applied, and the handle grasped in the right hand, the shank passing between the index and the medius fingers, the left hand supporting

the side of the jaw, a movement of torsion is given to it, tending to draw over the tooth to the side of the bolster. This movement should be gradual, and without shock: when the tooth yields, you may join to it a motion of elevation which throws the tooth out of the socket, and even sometimes out of the mouth; but, to accomplish this, you must have acquired a certain skill. The following circumstances occur: the adhesions of the tooth with the alveolar periosteum are destroyed, the dental cord torn, and a small portion of the alveolar process on the side to which the tooth is drawn is usually broken. The skill consists in breaking as little of this process as possible. Hence, also, the movement of elevation. Some try only to cause a partial luxation, in order to save the alveolar process—extracting with the forceps.

2. *With the "Tirtoir."*—Grasp the handle, with the thumb and index finger, as near as possible to the claw extremity; the bolster and the claw are applied as those of the key. We begin by a slight movement of reversion outwards; when it is felt to give, slightly raise the bolster on the gums, and recommence the movement of reversion, so as to progressively extract the tooth by these alternate movements, without fracturing the tooth or alveolar process. This is the best instrument, and the best plan for the extraction of teeth; unfortunately, it can only be used for the front teeth.

3. *With the Forceps.*—The tooth, well seized between the claws of the instrument, its teeth descending as near as possible to the alveoli, is first slightly rotated, then perpendicularly extracted. Many surgeons use the forceps alone for front teeth, even for very firm ones; but they run the chance of breaking them.

4. *With the Lever.*—Its extremity is passed between two teeth, a sound and the decayed one, or, a sound one and a stump, so that the sound tooth may serve as a fixed point, or the alveolar process and stump; in which case the fixed point is taken on the right index finger, or the left thumb. When the instrument is well engaged, it may be moved in two ways; if it be between two teeth, by a movement of torsion, they are separated, and the decayed one upset; or if between a tooth and stump, it is used as a lever of the first order, so as to raise the tooth out of its socket. The tooth on which we lean should be well supported; we should act gradually, and not loosen our hold on the instrument, or be afraid to return to the task several times if we fail at first. Whatever the instrument employed, when the tooth is once loosened, it should be extracted with the forceps. If it adheres much to the gum, it should be cut away with the gum-lancet. The tooth extracted, the gums should be squeezed together with the thumb and index, and the mouth rinsed with vinegar and water. The crown must be tolerably solid to allow of the employment of the three last instruments. When it is very hollow, it has been thought advisable to stop it first. It is better to use the lever.

Special Proceedings. 1. *Incisor teeth—Canines and small Molars (bicuspides).*—The forceps or tirtoir may be used, the former when they are loose, the latter when tight. We may if necessary have recourse to the key, and cause only partial luxation; but the length of

the root makes us fear, especially here, fracture of the alveolar processes, above all with the canines.

2. *Large Molars*.—They should always be drawn with the key; in the upper jaw, the direction of their roots, and the difficulty of taking a fixed point on the inside, give rise to the rule of reversing them outwards. The operator stands behind, or on one side of the patient, so as always to be able to act freely, and with the right hand. The fixed point should not be taken on the inside unless the other plan be absolutely impossible.

For the lower jaw, the surgeon stands in front; it is generally recommended also to reverse these teeth outwards; but often, for the second tooth, the very marked oblique line of the maxilla gives more thickness to the outside alveolar process, the bolster slips, and the tooth is broken, on account of this unyielding process; it is better then to reverse it inwards. The only thing to observe is, that the teeth are not so close together but that the external side of this tooth, always larger than the internal, can pass without injuring the neighbouring teeth.

We may also dislocate inwards the first great molar.

3. *Wise Teeth*.—In the upper jaw, the coronoid apophysis generally offers an insurmountable obstacle to the application of the key, especially when the tooth leans outwards, which is the case in many subjects. It is equally impossible to get a resting-point on the inside. We must then have recourse to a key armed with the Z shaped claw, which allows us to take our fixed point opposite the second molar; or push the lever between them, and dislocate the tooth backwards and slightly inwards.

The wise teeth of the lower jaw are more easily extracted. We can seize them with the key and simple claw, taking the fixed point on the inside; or, if necessary, use the lever.

4. *Extraction of Roots*.—The roots of the twenty anterior teeth should be extracted with the "tirtoir," the others with the key and sharp claw, when the neck of the tooth exists and offers any purchase; if they are loose, they will yield to the forceps; those which are neither very firm nor very loose, and touch or are close to a sound tooth, need the elevator.

5. *Extraction of Teeth placed inside or outside the Alveolar Border*.—These are generally incisors, or canines, or small molars; if they are external, they may be drawn as usual; but if internal, we cannot use the tirtoir or key except for some in the lower jaw. We must then have recourse to the lever, which is passed between them and the neighbouring teeth, on which we lean; after having sufficiently loosened them, extract with the forceps.

6. *Extraction of the Milk Teeth*.—This operation is more hurtful than useful; in general, they should be left to nature, but if it is decided on, the forceps will suffice; in consequence of the softness of the alveolar processes in young children, care must be taken that all the root is extracted. When the milk teeth, decayed at their roots, are in the way of the next teeth, we may reverse them outwards with the thumb without any difficulty.

Of the Accidents of the Operation.—These are: 1. Fracture of the tooth or alveoli, and crushing of the gums, which cannot always be avoided, and which needs no remedy when done.

2. Tearing the gums with a portion of the alveolar process; in this case, the tooth must be seized with the forceps, and extracted as soon as possible, tearing the gum as little as we can; it is not dangerous.

3. Loosening, luxating, or extracting at the same time a sound tooth; it should be immediately replaced.

4. Hemorrhage; an acidulated gargle is generally sufficient to stop the bleeding; if it resists, and continues from the bottom, the hollow should be plugged with wax; if it comes from somewhere else, and is very troublesome, we must have recourse to lint and agaric, maintained by a bit of linen and a bandage externally.

VII.—OF LUXATION OF TEETH.

The plan is the same as for extraction, only the tooth should be but half reversed, without being extracted. It should then be replaced with the finger, and attached to the neighbouring teeth, or covered with a small bit of linen, so that the patient, in shutting his mouth, presses it *in situ*; he should not be allowed to masticate for three or four days.

This operation is only performed on the twenty anterior teeth; in order that it succeed, the subject must be young, the gums healthy, and the tooth sound, or very little decayed; as this is performed to remove pain, the luxation must be sufficiently strong to break the nerve which supplies the tooth.

VIII.—TRANSPLANTATION OF TEETH.

It consists in replacing a tooth, immediately after its extraction, by one drawn from another person. Besides the barbarity of this operation, the difference in the form of the roots prevents its success. But when a tooth has been removed by mistake, it may be very well replaced. Sanchard has tried it, and we have ourselves had occasion to do it, and with success. It must be tied to the neighbouring teeth with a thread of gold or silk; if the other teeth are too far off, the interval may be filled up with a bit of cork, included in the ligature.

IX.—APPROXIMATION OF TEETH.

When the removal of a tooth leaves a mis-shapen vacancy, especially in front, the teeth thus separated may be tied together with well-waxed silk, passed round their necks; after two days, this ligature must be replaced by another, and so on, until the vacancy be filled up by the two neighbouring teeth, which takes place in the course of a month. We then substitute a bit of white thread for the silk, and leave it on for a month to maintain the teeth in apposition, until the alveolar processes are fixed, which takes another month. We need only try approximation between the ages of ten and thirty-six. This

age passed, we only loosen the teeth. Laforgue called it a sublime operation.

X.—REPLACEMENT OF TEETH.

We replace teeth out of their rank; but the operation has no chance of success after the age of thirty. We must try to replace a tooth only when there is a vacant space for it. If there is none, we extract it as ugly and useless. Sometimes, however, we do remove a tooth to make place for another that is out of its rank; thus, we sacrifice the bicuspid to save the canine; if there is no space, but the neighbouring teeth have some interval between them, we bring them nearer together, so as to make room. The replacement is made by means of a small plate of gold or ivory, made to fit, and pierced with holes for ligature. If the tooth projects inwards, the plate is put on the outside, and *vice versâ*; and the neck of the tooth is surrounded by a thread passed through the holes, and drawn more tightly every day. Sometimes we must also fix the plates to the neighbouring teeth. It has been advised, in order to replace certain teeth, to replace them with the forceps, and then operate on them with the plate and ligature. Laforgue rejects the operation.

CHAPTER IV.

OPERATIONS SPECIALLY AFFECTING THE SKIN AND CELLULAR TISSUE.

THE general operations, of which we shall here treat, are connected with the following subjects: 1. Abscesses. 2. Cysts, with liquid products. 3. Tumours. 4. Wounds and Foreign Bodies. 5. The restoration of Mutilated Parts. 6. Unhealthy Cicatrices.

SECTION I.—OF ABSCESSSES.

(1.) *Of the Opening of Abscesses generally.*

There are four ways of opening abscesses: caustics—seton—puncture—and incision.*

CAUSTICS.—The ancients employed the red hot iron, still used by some practitioners, for puncture. But the caustic potash is generally preferred. We have already given the rules for its employment; and will only add that the opening in the plaster should always be elon-

* As a general rule, an early opening is advantageous and requisite,—when matter forms beneath dense or aponeurotic tissues, which prevent its coming to the surface, and cause it to burrow and spread beneath them; or when extravasation of irritating fluids has taken place; or when an abscess forms in a loose and extensible cellular tissue, especially in the axilla and perineum—or in the neighbourhood of important organs into which it might open.—F. B.

gated, and that numerous fragments of the potash, of the size of a lentil, should be placed in it side by side, called "the caustic potash-train." The eschar produced is three times the size of the opening in the plaster. After twelve or twenty-four hours, the plaster is removed; sometimes the eschar is incised to give immediate exit to the pus, but if there is no hurry, it is left to detach itself naturally.

THE SETON.—A small band of linen is passed through two openings made in the abscess, either with the bistoury or trocar of B. Bell. This plan is almost out of use.

PUNCTURE. 1. *Simple Puncture. Ordinary Proceeding.**—It is performed with a lancet or bistoury on small abscesses, which need only be emptied for their cure.

Proceeding of Petit, of Lyons.—He made the puncture with an instrument heated to whiteness, and completely emptied the abscess by means of a cupping-glass; he says he has derived great benefit from this plan in phlegmonous abscesses.

2. *Puncture and Injection.*—Advised for some cold abscesses, with the intention of causing adhesive inflammation; for this purpose, the trocar is used. After having withdrawn the trocar, irritating injections are passed through its canula.

3. *Successive Punctures.*—Only employed in large abscesses (either lymphatic or congested) into which we would avoid the entrance of air.

Proceeding of Boyer.—A narrow bistoury is plunged obliquely into the lower part of the abscess, and a portion of the pus evacuated either by simple pressure, or by means of a cupping-glass. The little wound is then stopped with a bit of diachylum plaster; the abscess re-fills, and, after five or six days, but before it has reached its primitive size, it is again punctured, and so again, thus emptying it by degrees, giving time to the parietes to contract, and preventing the entrance of air. This proceeding has been lately renewed by J. Guérin.†

Proceeding of Récamier.—If the pus coming from an abscess, opened by puncture, be very fetid, and gives cause to fear dangerous absorption, we may apply to these abscesses the proceeding of M. Récamier for large hydatid cysts. That is, to completely empty the sac, and then, half or three parts fill it with an emollient injection. The trocar is then preferred for the puncture, and the cupping-glass for evacuation.

INCISION.—We have elsewhere sufficiently described the different kinds of incision. It will suffice to give here some general rules.

* A straight, narrow, or double-edged bistoury is to be preferred. It should be held between the thumb and two first fingers, the little finger resting on the neighbouring surface to render the hand more firm; the instrument should be plunged in perpendicularly until it reaches the cavity, which may be known by the escape of a drop of pus if the instrument is turned gently on its own axis. Then, in withdrawing the instrument, a sufficiently large opening should be made.—F. B.

† *Subcutaneous Puncture.*—In this way, psoas abscesses are treated; but sometimes a valvular opening is made by drawing aside the skin before puncturing, so that when it is let go the opening in it and that in the sac do not correspond. It has been recommended also to open large abscesses under water to prevent the entrance of air into the sac.—F. B.

1. In order to lessen the suffering of the patient, the abscess should, if possible, be incised with one stroke of the knife.

2. It is proper that one extremity of the incision should terminate in the lowest part of the abscess; it has also been recommended to make the incision in the direction of its greatest diameter, and, if possible, parallel to the axis of the body or well-marked folds of the skin. These two rules are subject to too many exceptions to be strictly preserved.

3. One opening is usually sufficient: it should be large enough to afford a free exit to the pus; if not, it should be enlarged with the bistoury and director.

4. When the abscess is very large, it is better to make several incisions than one of too great extent.

5. When a first incision does not reach the lowest part of the abscess, and when compression will not bring together the sides of the sinuses, recourse must be had to a counter opening, either by cutting down on the skin raised by a director introduced through the first opening, or by retaining the pus at the point where we wish to open it, and incising as for common abscesses.

6. When the abscess is prominent and superficial, incision from within outwards is preferred; but when the thickness of the parts prevents this, the incision should be made from without inwards with a straight bistoury.

7. When an abscess is situated under a muscle, it is better to separate its fibres than to cut them; but if this is not compatible with the direction of the incision, they may be cut across.

8. The incision made, the abscess is emptied by gentle pressure, without carrying the fingers inside, unless sinuses that may need opening are suspected; and generally a bit of oiled lint is placed between the lips of the wound, which is dispensed with after the second dressing.

(2.) *Of Opening very deep Abscesses.*

When the fluctuation is obscure, and we have to deal with important organs, recourse is had to the following proceedings:—

First Proceeding.—A convex bistoury is used, and the parts covering the abscess are divided, layer by layer, assuring ourselves with the finger, after each incision, of the position of the organs to be avoided, and trying to reach the fluctuation.

Second Proceeding.—A first incision is made in the skin; then with a director or the handle of a scalpel, the tissues are pulled aside, the bands of cellular membrane which oppose their separation being broken down, and we thus reach the purulent sac without using a cutting instrument.

Third Proceeding.—If, after having incised, layer by layer, a considerable thickness of tissue, we dare not proceed farther, either for fear of injuring important parts, or with the intention of allowing the abscess to point better, and burst of itself—we stop before penetrating to the sac, and fill the wound with lint; and, after some days, the abscess opens itself by the wound, even when the latter has not accorded

with its centre. This is explained partly by our having diminished at this point the resistance of the sides of the abscess, and partly by the extension, as far as the purulent sac, of the inflammation developed in the wound itself.

Dr. Graves, of Dublin, has applied this method to abscesses of the liver. We have seen Dupuytren recur to it with success for a deep abscess of the thigh.

(3.) *Of Particular Abscesses.*

1. *Abscess in the Face.*—They should be allowed to open of themselves to avoid the cicatrix, or be opened with a lancet if they are too slow. Those occupying the thickness of the cheek should be opened from the inside of the mouth.

2. *Abscess in the Parotid Region.*—I wait until the greatest part of the tumour is resolved in the abscess, and then make a large opening. Without these precautions, the aponeurotic layers, so abundant in this situation, give rise to long indurations, and sometimes numerous sinuses.

3. *Abscess in the Axilla.*—We should remember the position of the artery, situated almost at the union of the anterior with the middle third of the axilla. To avoid all danger, M. Velpeau advises raising the arm as much as possible, and plunging in the straight bistoury, held as a pen, from above downwards, so as to finish the incision from within outwards.

4. *Abscess of the Groin. Bubo.*—These abscesses may be opened with the bistoury, or caustic potash. The direction of the incision should be perpendicular to the fold of the groin. When it is made parallel to this fold, the lips of the incision turn in, and the cicatrization is difficult.

SECTION II.—CYSTS WITH LIQUID CONTENTS.

(1.) *Cysts of the Skin.*—(*Sebaceous Tumours.*)

Pathological Anatomy.—They are formed by the development of the sebaceous follicles of the skin, and are of variable size. When these cysts are very small, they are called “tarmes,” and their orifice shows itself by a black point on the exterior; but often this orifice no longer exists, the tumour gains considerable volume, and contains sometimes a viscid, transparent, or whitish fluid, or a pulpy substance resembling honey, pap, suet, wet bran, &c.* Their parietes seem formed of cartilaginous layers, slightly adherent to the subjacent cellular tissue.

Methods of Operation.—Injections, the seton, cauterization with caustic potash when the tumour is very large, with nitric acid on a straw or pen when it is small (Tenon), incision, excision, and extirpation, have all been proposed. The two last alone deserve a separate description.

* These were formerly called *meliceris*, *atheroma*, and *steatoma*.

EXTIRPATION. *Common Proceeding.*—The skin covering the tumour is incised longitudinally with a convex bistoury, without opening the cyst if possible; then it is separated from the surrounding cellular tissue, being raised and drawn away with the finger, tenaculum, or with the help of a thread passed through it.

Proceeding of Sir A. Cooper.—When the cyst is of long standing, and with indurated parietes, the surgeon cuts it, together with the skin, in the same incision, and empties all its contents; then, detaching its sides from the skin for a little extent, he seizes it well between the thumb and fingers of the right hand, provided with a compress to prevent their slipping, and draws out the cyst with some force, assisting himself by tearing the cellular tissue with the fingers of the left hand.—Dupuytren also followed this method. This operation is very slightly painful, and only lasts a minute. It heals by the first intention.

EXCISION. *Proceeding of Chopart.*—When the tumour has so large a base that its extirpation would leave an enormous wound, we may remove a piece of the skin and of the cyst from the most elevated part of the tumour, leaving the bottom of the cyst which unites with the edges of the skin. We begin by making an incision at the lowest part of the tumour through which it is emptied; then, slipping the finger into its interior, we raise the part to be removed, and excise it with the bistoury or scissors. After the operation, the hollow of the cyst exposed to the air acquires the hardness of leather, and is detached from time to time in layers; by degrees, the surrounding skin retracts, and in a short time the tissue of the cyst disappears, leaving a small cicatrix.

(2.) *Cysts of the Cellular Tissue.*—(*Serous, Mucous, &c.*)

Pathological Anatomy.—These are collections of serous or other liquids, more or less developed in the cellular tissue, sometimes borrowing from it an actual covering; at others, on the contrary, the liquid is in contact with a serous surface, without any real sac. It is impossible, *à priori*, to distinguish these cases; but, during the operation, we soon recognize the absence of parietes by the difficulty, or even the impossibility, of the dissection.

Methods of Operation.—They are the same as for the preceding tumours, with the exception of excision. But, if the cyst has no parietes, extirpation even should not be tried; an incision suffices; after which we should promote suppuration and adhesion in the cavity, by the introduction of lint or irritating injections.

If the cyst has a proper sac, we try to separate it from the surrounding parts with the fingers, scissors, or bistoury, avoiding opening it as much as possible; at least, if its parietes be not sufficiently thick to resist traction.

When the tumour is very large, and we choose incision, there is reason to fear lest so extensive an inflamed surface should give rise to troublesome symptoms—lest the air vitiate the pus, or the pus be re-absorbed. This is a case in which we should not entirely empty the tumour, but replace the pus or liquid evacuated by an injection

of warm water, that the parietes may shrink by degrees. This is the method of M. Récamier, already indicated for abscesses by congestion.

(3.) *Synovial Cysts.*

There are two sorts, one a kind of dropsy of the subcutaneous bursæ mucosæ, as on the olecranon, the patella, between the hyoid and thyroid cartilages, &c. The others consist in a development of the synovial bursæ of certain tendons, and are called specially ganglions.

1. *Synovial Cysts, properly so called.*—They should be widely incised; or, if the sac is large, an elliptical piece of integument may be removed, and then dry lint, or lint dipped in irritating liquid, be introduced to cause suppuration, and consequent adhesion of the walls of the cyst.

2. *Ganglions.*—Compression, opening by a very small incision, and rupture of the sac, without injury of the skin, by a blow with a smooth body, such as a book, or a stamp covered with linen, have each been advised.

Sabatier applied his left thumb on the ganglion, and pressed with his right upon the former, until the sac seemed burst, and the liquid spread in the cellular tissue. Slight pressure, followed by friction, renewed for two or three days, favours the absorption of the fluid, and the patient is cured.

I have tried this method, and obtained nothing from it. Some say they have seen compression succeed after a year, which would be too tedious for most patients, and could not be applied to all regions. I have invented a proceeding both for synovial cysts and ganglions, very efficacious, and with no other inconvenience than a little pain.

Proceeding of the Author.—The tumour being compressed laterally between the left index and thumb, so as to give it a considerable degree of tension, and to lengthen it in the direction of the axis of the limb, I take a straight bistoury with a narrow blade, held flat, and push it, parallel to the skin, into the inferior extremity of the large diameter of the tumour. I thrust the instrument sufficiently forwards to pass beyond the other end of the cyst, not through, but still under the integuments; and then, turning up the blade, I hold apart the lips of the little wound, to facilitate the exit of the synovia and small cartilaginous bodies frequently found in tumours of this kind, and whose exit I aid by compression. I then bring back the blade to the flat position, and cause its point to describe a quarter of a circle on the left side, so as to cut beneath the skin all that is in its way to within a few lines of the limit of the tumour; I turn the edge to the right, and do the same; then I turn it up to the skin, and divide in the same way all the envelops of the tumour. Lastly, carrying the point downwards, I scarify the bottom of the cyst, and withdraw the instrument, taking care not to lean heavy enough to wound the subjacent tissues.

It may be seen that, in the first three sections, the bistoury remains always under the skin, the circular movements are made with the

point, the heel resting in the little wound of the skin, which serves as a centre for all these movements; and the result is that the cyst has been divided in four points, absolutely, to use a common expression, as an apple, into four quarters, with an external incision not more than a quarter of an inch long. The tumour is then gently compressed to evacuate all the synovia; over it are applied layers of agaric covered with thick compresses, to keep up a soft and efficacious pressure; this compression should be maintained ten or twelve days, to avoid relapse. When there is no suppuration, the walls of the cyst contract adhesions which obliterate the cavity. Ganglions are, however, sometimes composed of a number of little cysts, in which case care must be taken that all are incised; those unaffected by the incision will remain.

I think we should class, with the synovial cysts, those pointed out by Dupuytren, on the articulations of the wrist, and foot, which almost always contain small white cartilaginous bodies, but which M. Kahn has, in our opinion, wrongly classed with hydatid cysts. They are always under the annular ligament, above and beneath which they project, and which divides them in two parts. Puncture, followed by evacuation of the liquid and small bodies, has once succeeded; at other times, the disease has returned. Dupuytren preferred the following method:—

Cause one of the tumours to project by compressing the other, and incise it; when you reach the cavity, pass in a director beneath the annular ligament to the second sac so as to raise the integuments, and assist you in making a counter-opening; that done, empty the cyst, and pass a seton from one opening to the other, or simply put a *mèche* of lint in each opening; the *mèche* or seton should be removed after thirty-six or forty hours. The irritation produced will cause adhesion of the walls of the cyst.

This operation is long and difficult, and often brings on violent inflammation, which spreads under the aponeurosis of the arm and hand, and ends in numerous abscesses. Once we have seen these accidents cause the death of the patient. I should prefer the subcutaneous incision described for synovial cysts and common ganglions.

(4.) *Hydatid Cysts.*

Cysts containing hydatids should be opened, carefully emptied, and then treated as cellular cysts.

SECTION III.—TUMOURS.

Tumours differ from abscesses and cysts in being always formed of solid products. They are either surrounded by a cyst, or, though without a cyst, are still isolated from the neighbouring tissues by a more or less loose cellular tissue; or, lastly, are so confounded with these tissues that we cannot determine their limits.

(1.) *Of Tumours in general.*

Methods of Exploration.—It is often difficult to determine the exact

nature of a tumour, or even to distinguish cysts containing liquid. When the situation is obscure, we have recourse to puncture to explore, using either the bistoury, the trocar, or acupuncture needle;* the bistoury is only suitable when the part is to be removed, and when we are undecided only about the method. The trocar, making a smaller wound, and being less likely to injure nerves or vessels, is preferable to the bistoury; the needle serves for cases in which the trocar is not without danger, as for tumours simulating aneurisms. It indicates, by the extent of its movements in the tumour, that there is an open cavity in it—a useful means of diagnosis, for example, in hydrocele, with thickening of the tunica vaginalis.

Methods of Extirpation.—Tumours are encountered with the knife, hot iron, ligature en masse, &c. The employment of the bistoury alone requires some general rules here.

1. It must be considered, before commencing the operation, what kind of incision is required to expose the tumour. The incision should vary according to the size, the base, the relations of the tumour, its adhesions, and the healthy or diseased state of the integuments.

2. *The Straight Incision*, allowing but a limited separation of its edges, is only suitable for the extirpation of small tumours, immediately under the skin, without adhesions, and capable of escaping through the opening on slight pressure. This is called enucleation.

3. *Incision on a fold of skin* is fit for encysted tumours, which we fear to open, or for solid tumours which we wish to remove entire, for fear of leaving behind any portion capable of reproducing them.

4. *The Elliptical Incision* is preferable whenever we wish to remove, with the tumour, a flap of integuments, whether because it is diseased, or because the skin is thinned and would with difficulty reunite; or when the extent of the integuments much surpasses that of the wound to be covered.

5. *Crucial or T or V Incisions* are indicated when we would expose a large tumour, without removing any of the skin that covers it.

6. Whatever kind of incision is preferred, it should extend to the base of the tumour, so as to permit a free dissection, and only leave a sufficient extent of skin to exactly cover the wound.

7. Dissect by extensive cuts, directing the edge of the bistoury as much as possible towards the tumour or healthy part, according as we would preserve one or the other.

8. Take care of the neighbouring organs, nerves, vessels, muscles, &c., putting them on one side with the fingers or forceps, or in any other way.

9. We must make sure, when the principal mass of the tumour has been removed, that not a bit is left behind, especially if the tumour is of a suspicious character; the remnants that are left may be

* We prefer the instrument used in England, called the "exploring needle." It is a long needle, flattened on one surface, along which surface runs a deep groove; in this groove a portion of the contents of the tumour generally lodges, and may be examined when the instrument is withdrawn.—F. B.

removed with the knife or scissors, or destroyed by the actual cautery.

10. When the tumour is enormous, we must only uncover and remove a portion at a time; after some days, when the inflammation is gone down, another portion; and so on till all is extirpated.

11. The wound should not be dressed till all the vessels are tied, and all flow of blood has ceased; they are then generally united by first intention, by means of sutures or adhesive bandages.

(2.) *Of some Particular Tumours.*

I. **ENCYSTED TUMOURS.**—Their nature may vary, but their relations only interest the operator. The skin and cyst which cover them being divided, we place the fingers on the sides of the tumour and squeeze it, so as to make it come out; as soon as it projects beyond the skin, seize it with the fingers or claw forceps, and with the bistoury, or with the scissors, cut the cellular bands which still attach it to the bottom of the wound. For these tumours, as for all the subcutaneous cysts, M. Alliot makes a semicircular incision along the base of the tumour, dissects its base, turns it over with the skin that covers it, and finishes by detaching it from the integuments. I followed this plan for the removal of a small lipoma; but I found that, in finishing the section of the integuments from within outwards, I made but an uneven and notched section. It is only fit, then, for cases in which a simple incision suffices for the removal of the tumour without excision of the skin covering it.

II. **FATTY TUMOURS, OR LIPOMA.**—These tumours in most cases only slightly adhere to the neighbouring tissues. They present themselves under three forms.

1. *A flat Tumour with a large Base.*—Incise the skin down to the surface of the tumour, and dissect it to the right and left with the handle of the scalpel or fingers; it is rarely necessary to use the edge; then turn it over, seizing it with a tenaculum, and separate the last adhesions with the scissors.

2. *Large and very prominent Tumours.*—Here we must generally remove a flap of integument, and use the bistoury to dissect, the adhesions being more firm.

3. *Pedunculated Tumour.*—We may remove it by dissection, leaving only enough skin to cover the wound; or place a ligature on the pedicle, after having first circularly incised the skin. If the patient dreads the bistoury, Sabatier advises to steep the ligature in nitric acid, and to apply it on the skin, which is destroyed by the caustic without much pain, and the ligature afterwards causes none.

III. **SCIRRHOUS AND CARCINOMATOUS TUMOURS.**—For these the knife, actual cautery, caustics, ligature, and compression are used. Each may be useful according to the case;—we have nothing to add to the general rules. M. Ollivier advises inoculating the centre of these, and generally all tumours of as grave a nature, with hospital pus—a desperate resource, which no prudent surgeon would attempt to practice.

It is not the same with the method proposed by M. Martinet de la

Creuse to obviate relapse—which consists in borrowing a flap of skin from another part to cover the wound. This practice has succeeded with him several times in desperate cases. As to the operation, it does not differ from the ordinary autoplastic operations.

IV. MEDULLARY FUNGUS AND FUNGUS HEMATODES.—Extirpation alone is proposable; and often, when the tumour is situated in a limb, we must have recourse even to amputation.

V. ERECTILE TUMOURS.—Under this general name are comprised tumours very different in their nature and size; from *nævi materni* to accidental erectile tissue; from congenital varicose tumours to aneurism by anastomosis. M. A. Bérard makes three classes, according as the lesion affects the capillary vessels of the skin, the subcutaneous veins, or arterial branches. We may understand, by this fact, the difficulty of appreciating the nature of the numerous proceedings that have been proposed, often without distinction of the true character of the tumour.

We may, at all events, class these proceedings into three grand methods, according as they are intended: 1. To stop the blood from reaching the tumour; 2. To obliterate the dilated vessels of the tumour by inflammation; 3. To cause the destruction and removal of the tumour.

The *first* method comprises four different proceedings:—

1. *Astringent and Refrigerating Topics*.—Means of little efficacy; which, nevertheless, once succeeded with Abernethy on a pretty large congenital tumour.

2. *Compression*.—An uncertain and often dangerous proceeding when the tumour is large, but which may be useful for small tumours situated in such a way that they may be exactly flattened.

3. *Ligature of the Arteries*.—On compressing the arteries that go to these tumours, we observe them become loose and soft; their volume diminishes; hence the idea of tying all the second class arteries, an attempt which has not been successful. More success, however, has been obtained from tying the principal trunk—for instance, the carotid for erectile tumours of the ear, orbit, &c. Still, in many cases, the tumour has reappeared; and this plan does not promise invariably certain results.

4. *Circular Incision at the Base of the Tumour*.—Performed by Physick, to make sure of dividing all its vessels. The incision must be made on healthy tissues, and comprise all the depth of the skin and subjacent cellular tissue with their vessels. Tie as you go on; and fill the wound with lint, to prevent immediate reunion.

The *second* method comprises six proceedings:—

1. *Puncture and breaking up*.—It has been proposed to plunge into the tumour a cataract needle, with which the morbid tissues should be broken up. I do not know that this idea has been put in execution.

2. *Vaccination*.—Mr. Cumin proposes numerous inoculations with vaccine, in order to excite a special inflammation, which may change the condition of the vitality of the tumour. This can only succeed in the most superficial *nævi materni*.

3. *Tattooing*.—I class this plan with the preceding, because it seems to me to act principally in the same manner, although its inventor, M. Pauli, put it into practice with a very different intention.

We know that soldiers tattoo their arms and breast, and impress and trace on them words and figures that neither lotions nor even blisters can efface. M. Pauli thought that, if he could colour the skin blue or red, he might in like manner colour it white in the cases in which the superficial nævus has given it the tint commonly called ("taches de vin") wine spots. He says he has already, in this way, obtained some success.

This is the proceeding adopted by the soldiers. They first mark upon the skin with red chalk the characters they wish to trace, then cover the part with the chosen colour, vermilion or indigo; then, taking a cork, in which are fixed three pins whose points are of equal length beyond the cork, the operator pushes the points obliquely into the skin until a drop of blood flows; then the parts are again rubbed with the chosen colour. The pain is very slight, and the coloration indelible.

To apply this plan to the nævus, the parts are first washed with soapy water, and then rubbed, to make the blood penetrate into the extreme ramifications of the erectile tissue. The skin is then extended, and covered with a layer of colour of the same shade as the healthy skin, made with *white lead* and vermilion, and pricked with three pins, dipped from time to time in the colour. When the nævus is very extensive, we proceed bit by bit to avoid considerable swelling.

The difficult point, according to M. Pauli, is the choice of colour. It requires almost the practiced eye of the painter. Generally, it should be lighter than the tint we wish to obtain. When the spot is on the cheek, it is necessary to give it a more-rosy hue.

4. *The Seton*.—Macilwain passes one or more setons across the tumour to produce enough inflammation to obliterate its vessels. He sometimes succeeded. More recently, A. Bérard has resumed this method for extensive and deep venous tumours; but, after five or six days' employment of the seton, he passes each extremity of it through small balls of ivory (the "serre næud" of Roderic), to tighten them and produce a kind of semi-strangulation in the tumour.

5. *Needles*. *Plan of M. Lallemand*.—He uses long fine pins, such as are used for fixing small insects. The finest should not be employed, because their presence does not determine enough inflammation. They remain often eight days without producing suppuration. He prefers pins to needles, because they penetrate just as well, on account of the softness of the erectile tissue; and especially because we may bend or cut them off as may be necessary.

These pins are pushed in so as to traverse the tumour, or a portion of it, from side to side. We may introduce from four to a dozen at a time, disposed as parallelly, and as near to one another, as possible. If we have only been able to include part of the tumour, three days afterwards we introduce a second dozen in another portion. M. Lal-

lemand has passed in this way at least 120 into one tumour. They are left *in situ* seven or eight days or more, until suppuration is well established, when we withdraw them. After the removal of a first series of parallel pins, if the inflammation does not appear sufficient to produce a cure, we introduce more, in a direction perpendicular to them, before the inflammation has subsided.

At first, M. Lallemand passed waxed threads round these pins to compress the parts, augment the inflammation, and prevent the flow of blood. But this compression adds nothing to the effect of the pins, for the pins completely stop hemorrhage from the first moment; and afterwards, the inflammation, spreading from the divided surfaces, obliterates the injured vessels entirely. These threads are then useless: but, after the introduction of the first pin, it is well to raise it with a thread, to enable you to pass the second more deeply, and so on, so that the erectile tissue may be embraced in all its thickness. The parts thus traversed swell, assume a violet, and even blackish, hue, and a sanious and bloody discharge exudes. There is no need of being frightened at this; the vessels become obliterated by the effect of this inflammation, the erectile is changed into fibrous tissue, and, in a case where a red tumour, three inches in diameter, occupied the cheek, this transformation reduced the tumour to the state of a pale, even, polished surface, like the cicatrices that follow a superficial burn. I had occasion to employ this method on a child who had a nævus at the root of the nose of a violet colour, and nearly as large as a quarter franc piece (a coin a little less than the English four-penny piece). The pins produced no swelling nor suppuration; and yet the colour of the nævus disappeared in the parts pricked, giving place to a rosy hue. We may then conclude that, in slight cases, needles are innocuous; but their efficacy is not constant, and, in other attempts, I have not been able by their means to determine a sufficient degree of inflammation to obliterate the dilated vessels.

6. *Incision*.—This proceeding was published in 1833 by an English surgeon, who did not give his name.

A long and deep incision is made, dividing in its greatest length and entire thickness the erectile tumour. The bistoury is passed where the arterial dilatations are most numerous and prominent. A large jet of blood flows out immediately. A fine sponge is placed all over the tumour, and compressed for some seconds, so as to express all the blood from the tumour. Then a bit of lint is placed between the lips of the wound, and another bit of sponge about an inch thick is placed all over the tumour, extending beyond its circumference (instead of the first bit, which only compressed the borders), and fixed by strapping and a bandage. This compression does not allow the blood to flow. The consequent suppurative inflammation tends to obliterate the vessels of the tumour, and even those in the neighbourhood, and the cure is usually completed in a few weeks.

This is the method of Richerand for common varicose tumours, applied to aneurism by anastomosis; two affections which, in fact, only differ, it may be said, in the nature of the vessels dilated. Perhaps the operation would be simplified if the circumference of the

tumour, and even the tumour itself, were compressed before the incision was made. A hemorrhage, at all events useless, would thus be avoided. M. Lallemand has succeeded by simply incising the tumour, and re-uniting the wound by the twisted suture.

The *third* method includes five proceedings:—

1. *Ligature*.—White says he passed a needle across a large erectile mass, and tied with success each half; but this plan does not give assurance that no portion of the tumour is left behind, and exposes to hemorrhage and evil consequences.

Gensoul applied one ligature when the base of the tumour was small, and the neighbouring skin soft enough to permit raising and sufficiently isolating the tumour.

Keate passed under the base a straight needle or two, crossing each other if the tumour was very large, and tied a thread under the needles.*

2. *Actual Caутery*.—Maunoir obtained complete success with it. Dupuytren regarded it as one of the most reasonable and powerful means; but, the results being more serious than those of extirpation with the bistoury, its employment should be reserved for tumours too extended, too thin, and too confounded with the healthy tissues to allow a possibility of extirpation;—or for destroying the debris of morbid tissue that might have escaped the bistoury.

3. *Caustics*.—M. Guthrie recommends nitrate of silver when the nævus is not very large or thick. The injection of a solution of six drops of nitric acid to 3ss of water into the interior of the tumour, by means of Anel's syringe, through a small puncture, has also been recommended. M. A. Bérard, for superficial or capillary tumours, prefers the caustic of Vienna spread on the tumour, and left for five or ten minutes, and repeated if necessary. For extensive and deep venous tumours he passes in, first, six or twelve pins, and at the end of five or six days withdraws them, and injects through the holes nitric oxide of mercury; but he admits that this plan is dangerous, and prefers seton with strangulation.

Method of Wardrop.—He applied caustic potash, not for the purpose of destroying the tumour by the caustic itself, but in order to determine ulceration in it, which, according to what he has observed, rapidly spreads through the whole of this kind of tumour. A bit of plaster with a hole in it is applied on one point of the tumour, to limit the action of the potash, and the skin rubbed with a pencil of the caustic, until the colour of the integuments indicates the formation of an eschar. If after two or three days he finds that the eschar is too superficial, he repeats the friction with caustic, or even establishes another eschar on a different part of the tumour.

* Mr. Liston recommends passing two armed needles across the base of the tumour, and tying it in four portions. One needle was first introduced across the morbid mass, without a ligature, after the skin had been reflected from it by a crucial incision. "The tumour was raised by means of it, and a second needle passed underneath the first, carrying a strong thread; the loop of this was laid hold of with a hook, and the needle withdrawn upon the ligature; the first needle was then armed also, and the double ligature brought through with it. These were then secured."—Page 331, Liston's Op. Surgery.

The eschar formed is not touched ; ulceration comes on underneath, revealing its progress by the dissolution of the tumour, which disappears without the ulceration spreading farther than the healthy parts. Wardrop thinks that all *nævi materni* may be successfully treated in this way.

4. *Inoculation with Hospital Pus*.—Proposed by Ollivier ; a resource too dangerous, and one which also has never yet been tried.

5. *Extirpation* should be performed with the scalpel with the greatest care. A precept, to which much importance has been attached lately, is to dissect as far off as possible from the limits of the tumour. The nearer we get, the more vessels there are to tie. In incising the tumour itself, an enormous and uncontrollable hemorrhage is to be feared. If then any part of the tumour has escaped the knife, we should have recourse to the actual cautery.

M. Lallemand has shown that these fears are exaggerated. In a case where the complete removal of the tumour would have caused too much deformity, he contented himself with removing a portion of it, and uniting the rest with pins. The cure was prompt and complete. Most of these methods may be useful ; circumstances alone should direct the surgeon's choice.

SECTION IV.—WOUNDS AND FOREIGN BODIES.

Wounds by simple puncture seldom require the employment of instruments. To wounds by cutting instruments we apply the methods of reunion already studied. Lacerated wounds require nothing more than the excision occasionally of the torn flaps which project beyond the wound. This may be done with the bistoury or scissors.

(1.) *Of the Bites of Rabid Animals.*

It is advisable, in order to prevent the absorption of the virus, to wash the wound ; apply cupping-glasses ; place a ligature between the wounded part and the heart ; open the veins whose radicles are near the wound ; and, lastly, cauterize. The actual cautery or caustics may be used. The latter are preferred, and amongst them especially the butter of antimony. The rules for cauterization have been given. We only add that it is of the highest importance not to leave a bit of the wound uncauterized.

The same rules apply to the bites of venomous animals ; but the bite of the viper is rarely bad enough to need cauterization. When it seems to be indicated, we may employ the *eau de Luce** (Jussieu), potassa (Fountain), a bit of cotton steeped in alcohol, which is burnt in the wound, &c.

(2.) *Of Gunshot Wounds.*

Setting aside the complications they share with other wounds, they of themselves require but one operation—dilatation. There has been a difference of opinion on this point between French and Eng-

* Tinct. ammoniæ, Comp. P. L.

lish surgeons. The former, in almost all cases, with the intention of converting the contused into an incised wound, and to prevent constriction, recommend dilatation as soon as possible, and that the incision be carried through all the course of the wound. But John Hunter has well remarked that wounds not dilated generally heal much sooner than those dilated; and that the incisions tend to increase the inflammation, which is the principal cause of the constriction. We agree completely on this point with the English doctrine, and restrict dilatation to the following cases:—

1. When the ball has traversed aponeurotic tissues, and the first signs of constriction have shown themselves.

2. When the wound must be enlarged for the extraction of foreign bodies, splinters of bone, or for the ligature of vessels.

It is only in the latter cases that we should open the whole course of the wound down to the vessel to be tied, or foreign body to be extracted. If we only have to put an end to the commencing constriction, it suffices to incise the fibrous tissues producing it.

These are the general rules:—

1. Dilate parallelly to the axis of the limb, carefully avoiding the nerves and vessels.

2. Guide your knife with the finger or director, and cut from within outwards. We may well use in this case the straight, button-pointed bistoury.

3. Enlarge the wound as much as possible on its most depending side, to favour the exit of the pus.

4. If the flesh is confined by aponeuroses, cut these first lengthwise, then across, or even in stars if necessary.

5. Prolong the incision through the whole extent of the constriction.

6. Dress the wound simply, avoiding reunion by the first intention.

Dilatation is only applied to wounds of the limbs and cranium. It is excluded from the treatment of penetrating wounds of the thorax or abdomen.

(3.) *Foreign Bodies with or without Wounds.*

Foreign bodies are of many kinds. One kind, rounded or otherwise, but whose three dimensions only slightly differ, is driven by some force or other into the depth of the tissues without, so to say, leaving anything outside to grasp it by; for instance, balls, pieces of lead, grains of powder, wadding, a bit of cloth, &c. Others have an elongated form, and may be taken hold of by one of their extremities, as the blade of a knife or sword, a splinter, &c. Generally, they are accompanied by the wound which served to admit them; but frequently a ball or a needle is lost in the tissues, and remains there after the wound is closed.

I. *Extraction of Balls.*—This operation is performed with the fingers when the ball is within reach, and not tightly held (which is very rare), or with instruments. Percy advised the forceps, spoon-shaped scoop, and the gouge, when the ball is incrustated in a bone. He

united them in the one instrument called a "tribulcon." The gouge is properly rejected; the tribulcon and scoop, though of some utility, are generally replaced by the forceps. Dressing forceps may be used; but we prefer polypus forceps, whose extremities form an open spoon, and especially those invented by Charrière, the handles of which, being crossed one on the other, permit its branches to be opened almost parallelly.

The general rules are:—

1. First of all, to assure one's self of the position of the ball by examining the course of the wound, finding out the posture of the patient at the time of the blow, probing the wound, and exploring all the parts of the surface of the limb or trunk to which we suppose the ball may have gone.

2. To make all necessary dilatation down to it, so as to give it a free passage.

3. To carefully incise on it the cellular tissue, which holds it sometimes as in a sac.

4. If it is too far from the external opening, and very near another part of the surface of the limb, we should incise at this point on the projection formed by it.

5. If it is buried in a bone, and its extraction be considered necessary, we may trepan. If not, leave it alone, and the wound sometimes heals as well.

6. If it is so deeply hidden in the soft parts that we cannot feel it, or that enormous incisions are necessary to enable us to reach it, it may be abandoned to nature.

7. If it is inclosed between two tendons, we are sometimes obliged to cut one across to remove it.

8. If it is retained between two bones, as in the leg, forearm, metacarpus, or metatarsus, it may be loosened and disengaged with the small end of a common spatula.

9. If there is any reason to fear hemorrhage during these attempts, the principal artery should be compressed, or the tourniquet applied.

II. *Extraction of other substances not prominent externally.*—Grains of powder in the skin may be extracted with a needle—a minute operation, from which perfect success must not be expected. Splinters of bone, wood, or glass, or bits of cloth, are extracted with the dressing or dissecting forceps, after necessary dilatation.

If any foreign body remains in the tissues after the cicatrization of the wound, we wait to extract it until it causes a well-marked projection beneath the skin, then cut down on it, and withdraw it with the forceps.

III. *Extraction of Foreign Bodies, leaving a purchase externally.*—If the blade of a knife or sword is pushed into the flesh, and leaves on the outside a portion that may be grasped, it should be drawn out by this portion. If the blade is broken, and cannot be seized with the fingers, we use a very strong pincers, its teeth being covered with cloth, to hinder them from slipping on the blade.

If the blade resists, and is buried in the osseous parts, one of three cases may exist:—

1. We may be able to lay hold of it on the outside; when we have recourse to the strongest pincers, sometimes we are obliged to put the foot on a neighbouring part to make an opposing force to the required effort of traction.

2. The blade, broken off on a level with the bone, projects into a cavity, as the mouth or breast. In this case we may arm the finger with a thimble, pass it into the cavity, and push back the blade. Of course this plan can be adopted on the breast only when there already exists a sufficiently large penetrating wound.

3. Or the blade offers no projection either outside or in a cavity. If it causes serious accidents, we trepan the bone to obtain some purchase outside. If the consequences are slight, wait until suppuration and inflammation have softened the tissues, and give a little play to the foreign body.

(4.) *Wounds with Loss of Substance.*

Wounds by burning, the sabre, or ball, &c., often cause a loss of substance which is only repaired by a more or less deformed cicatrix, or which leaves an ugly mutilation. But the operations to be tried in these cases are described in the two following articles:—

SECTION V.—RESTORATION OF MUTILATED PARTS, OR SURGICAL AUTOPLASTY.

The principle on which this important section of surgical operations rests, is the possibility of reuniting portions brought from one part of the body of the same individual to another. Sometimes a flap is taken from the parts near the loss of substance, sometimes from a distance; whence arise two grand methods. The first is subdivided into two others, according as the flap has a large base or a simple pedicle. The method with a large base belongs to the ancient proceeding, or plan of Celsus; the pedicle to the Indian plan. The autoplasty at a distance is called the method of Tayliocozzi, or Italian method (Taliacotian operation).

M. Roux has combined the Italian and Indian methods. Having to remedy a loss of substance in the ala nasi and upper part of the cheek, he borrowed a flap from the under lip, and grafted it on the upper. When its adhesions were well solidified, he detached it again to transport it to the required point; but we are very rarely obliged to recur to a like plan.

Autoplasty is subject to some general rules.

1. All regions are not equally suitable for the formation of flaps. Generally, the skin must present a certain mobility, but without being too isolated from the subjacent cellular tissue. On the contrary, when the flap adheres to this tissue, it will have a more favourable consistence; whence partly, the superiority of the frontal over brachial rhinoplasty.

2. A still more important consideration is the existence of vascular trunks in the pedicle of the flap. In this respect the skin of the cranium and face has the advantage over that of other regions.

3. It is necessary in general to give to the flap the shape of the part to be covered; but it is useless to attend too much to this shape, as the cicatrization never leaves it as it was first modelled.

4. The flap should always be cut larger than the part to be covered, generally one-third larger; but this rule is subordinate to the extent of the loss of substance.

5. There is less retraction of the flap in its thickness, but it should never be reduced to integument only; the vessels going to the skin almost perpendicularly would be divided, and mortification be almost inevitable.

6. As much as possible the pedicle should be made on the side from which the vessels come, so as to favour the current of blood. Dieffenbach has laid down a contrary precept. He thinks that the flap generally dies of congestion, and would divide all the vascular trunks; but experience appears to contradict these views.

7. The flap should be reunited by the first intention, and by points of suture more or less numerous; but in some cases compression alone is sufficient to maintain it *in situ*.

8. The flap having been put in place, the wound resulting from the dissection should be dressed. It has been proposed to heal it by dissecting its edges, and drawing them together. This is not always necessary. Thus in rhinoplasty the cicatrix on the forehead, when left to nature, is not larger than that which we attempt to favour by bringing the skin together (Blandin).

9. Immediately after its separation the flap becomes pale and cold. Cold applications are then most suitable for stimulating it. If after some hours, it becomes swollen and blue, it is well, in order to remove the engorgement, to apply some leeches on its most eccentric parts.

10. At first compression should be avoided, especially towards the pedicle; but when all fear of gangrene is dissipated, a slight compression on the flap is necessary, to prevent its curling up, and if necessary to efface the projection caused by the twisting of the pedicle. This compression should be continued during the whole time of cicatrization, and even afterwards, to counteract the retractability of the tissue of the cicatrix.

1. METHOD OF CELSUS, consists in repairing the loss of substance at the expense of the neighbouring skin, dissected and elongated in various ways.

Old Proceeding.—Begin by refreshing the borders of the solution of continuity, so as to give it an elliptical or angular shape; then dissecting the skin on each side, bring the edges together towards the middle of the wound, so as to have a linear cicatrix, and maintain them by stitches. When the skin does not give out enough, notwithstanding the previous dissection, it is necessary to make, beyond the point to which the dissection has been carried, a semilunar incision for each flap, with its concavity looking towards the wound, and not penetrating deeper than the skin. In this way we may draw much farther and more easily the two flaps—which still adhere by their lateral parts to the skin, and by their under-surfaces to the subjacent cellular tissue. Dieffenbach has revived this method with success.

Proceeding of Chopart.—After having refreshed the edges of the wound so as to leave them rectangular, he makes from the angles two parallel incisions, circumscribing a quadrilateral flap detached on three sides and dissects this flap, which is easily elongated, and sometimes of itself alone covers the entire wound. If necessary, another may be made on the other side in the same manner. He also unites by suture.

Proceeding of Roux de Saint Maximin.—This is the old method, but with only one flap. It is especially applicable to parts whose anatomical disposition only permits dissection on one side of the wound. M. Roux never uses the semilunar incision of Celsus; to increase the extensibility of his flap, he gives it more width, making an incision at each end of the wound, in the direction of its length.

Proceeding of Lisfranc.—As in the proceeding of Roux, only one side of the wound is dissected; but to facilitate the dissection, he commences by dividing this flap in two, by an incision which falls perpendicularly on the wound itself.

2. ITALIAN METHOD.—The flap required is borrowed from some distant part, more particularly from the skin of the arm. After having refreshed the edges of the wound, a model is made in wax, or a piece of paper is cut out, of the requisite shape and size to fill up the loss of substance. This paper is applied, on the arm for instance, and with the bistoury a similar flap is circumscribed, comprising the entire skin, and is dissected off except at its pedicle, which should be left large enough to maintain the circulation. The flap is applied upon the wound to be closed, and made fast by sutures, the arm being retained by proper bandages in such a position that reunion can take place without hinderance by strain. The union having been effected, the pedicle of the flap is cut, and the bandages and sutures removed; the loss of substance is repaired, the arm becomes again free, and we have only to heal the wound in it. It was Graefe who first matured reunion by first intention, and wished to give to the plan thus conceived the ambitious title of the "German method." Tagliacozzi allowed the flap from the arm to suppurate before he applied it.

3. INDIAN METHOD.—A flap, large enough to cover the entire wound, is in like manner marked out; but, instead of taking it from the arm, it is borrowed from the integuments adjacent to the solution of continuity. In order that all the parts may be in the necessary relations for reunion, it is indispensable that the pedicle of the flap be close to the wound; so that we have only to reverse the flap, and twist its pedicle half round to apply it.

There are four principal proceedings.

Common Proceeding.—The two incisions that laterally circumscribe the pedicle approach each other at an equal distance from the edge of the wound, but without touching it. The result is, that when the flap is turned over, its bleeding surface is upwards; and to put it downwards we must twist the pedicle to 180° , which may destroy the circulation and cause gangrene. Afterwards we are obliged to cut the pedicle to avoid deformity.

Proceeding of Lisfranc.—He prolongs one of the incisions at the pedicle one-fourth of an inch beyond the other. In this way one side of the pedicle is a little more strained than the other; but the torsion is much less, and we may even dispense with the subsequent section of the pedicle.

Proceeding of Lallemand.—He prolongs one of the incisions even to the wound itself, whilst the other terminates far enough off to leave sufficient breadth to the pedicle. In this manner the torsion almost completely disappears. There is only a lateral displacement of the flap and pedicle, and the deformity is still less than in the plan of Lisfranc. This, then, is the plan to be preferred, unless under special circumstances.

Proceeding of Jameson.—To perfectly obliterate the crural canal occupied by a hernia, he cut from the neighbouring integuments a flap one inch and a half long, and three-quarters of an inch broad, turned it over, and introduced it into the canal. The external wound was reunited; the operation perfectly succeeded. This method would be applicable to all narrow and deep fistulæ. M. Velpeau successfully applied it to a tracheal fistula with the simple modification of rolling the flap in the shape of a cork to introduce it into the fistula.

Appreciation.—Each of these methods, each of these proceedings, may be preferable to the others under certain circumstances. In general, the method of Celsus is useful only when the skin is loose and extensible, or the space to be filled up small. As to the two others, the Indian method is the most easy; but it leaves a large cicatrix in parts sometimes too visible, as in the forehead in rhinoplasty. The Italian method, in its turn, necessitates a confined position of the arm, which must be continued for some time, and is horribly fatiguing. We must choose between these two inconveniences.

In all these operations we may secure the flap with sutures; the only exception is when we have portions of cicatrices on the edges of the flap or wound, in which case the suture would infallibly tear through them. The edges of the wound may be refreshed with caustic or blisters, but generally the bistoury is better.

SECTION VI.—OF VICIOUS CICATRICES.

Pathological Anatomy.—The cicatrices, formed by the exudation and organization of plastic lymph on the surface of suppurating wounds, first show themselves as a thin pellicle, red, easily broken, and already possessing sufficient retractility to draw together the borders of the wound, more or less, towards the centre. They are always smaller than the loss of substance they replace. During many weeks, months, or even a much longer time, they gradually become more perfect, and progressively thicken, shrinking more and more, so as to draw the skin in different directions, and form unshapely contractions, which hinder motion, and are incapable of extension. This consecutive retraction only ends when the cicatrix becomes white and solid; when, in fact, its organization is perfected. Then

we find the cicatrix formed beneath a thin layer of epidermis by a dense tissue, whose fibres interlace in all directions. This is called the "*tissu de cicatrix*" (Dupuytren), "*inodules*"* or "*tissu inodulaire*" (Delpech). The cicatrix adheres intimately to the subjacent parts, and inflammation destroys its tissue with extraordinary rapidity. Whence the important recommendation to avoid making incisions on them, or in their immediate neighbourhood, unless in cases of absolute necessity.

The deformities, consequent on cicatrices, which call for the use of instruments, are comprised under the following five heads: 1. Prominent cicatrices; 2. Warty tumours; 3. Too narrow cicatrices; 4. Adhesions; 5. Abnormal obliterations.

(1.) *Of Prominent Cicatrices.*

When the cicatrix is thin, it may be destroyed by the repeated application of nitrate of silver; if of greater substance, a thin double-edged knife may be passed flat into the middle of it, and carried through to the edges, shaving the skin so as to completely remove all that surpasses the required level; then the edges should be kept apart, the surface should be dressed, and repeatedly touched with caustic to keep down any fresh prominences.

(2.) *Of Warty Tumours of Cicatrices.*

Mr. Hawkins calls by this name tumours that develop themselves on cicatrices—first in the shape of a wart; afterwards taking on the appearance of a fungus, which bleeds when it is touched; finishing by ulcerating and becoming gangrenous, fresh tumours appearing in the vicinity. Caustics often fail. Complete removal with the knife is the most efficacious plan.

Lisfranc saw a fibrous tumour half as large as the fist develop itself under the cicatrix from an amputation of the second toe. Exstirpation was practiced with success.

(3.) *Cicatrices too narrow or contracted.*

We understand, by this title, cicatrices that bring together parts so distant that adherence between them is impossible. For example, when the head is inclined to the shoulder, the shoulder to the hip, and the various contortions of limbs flexed or extended by bridles or contractions, &c. There are two principal methods of remedying these cases—one consisting in removing all the cicatrix, and restoring the loss of substance by the autoplasmic method already described; the other, more ancient, which preserves and tends to enlarge the cicatrix itself.

Ancient Method.—Incisions are made on one or several points of the length of the contraction, dividing it in its whole extent and thickness; then the parts are extended in an opposite direction to that imposed on them by the cicatrix, and kept extended either by means of position, or by bandages or machines. When the parts are supple

* Th. Ἰνoειδής (ἰς, εἴδος), like a fibre.

and capable of extension, they may at once be brought to the position in which they are to be kept during the entire treatment; if unyielding, this process may cause dreadful pain, violent inflammation, and even gangrene. It is better, then, to proceed slowly by degrees; and even instead of inflexible splints, to use elastic springs, which procure an extension at the same time gentle and permanent.

The surface of the wound is dressed, and cicatrization favoured. If new and fresh contractions form, which is not infrequent, they should be cut without hesitation. This is an important precept, on which depends the success of the operation. It is Dupuytren's method, but he did not obtain the best success from it; M. Amussat, however, has recently given to it so great an extension, that he has almost formed a new method of it.

When a part has been divided, the reunion of which should be prevented, whether there has or has not been a pre-existing cicatrix, the suppurating surfaces tend to approach each other, because they both become covered at the same time by a membrane "inodulaire," the retractility of which draws them together. The continuity of this membrane should then be broken, so that the cicatrix of one surface may be formed separately and independently of the other. In order to effect this, as soon as suppuration is established, divide bit by bit, every twenty-four hours, the angle of union of these two surfaces where the membrane "inodulaire" passes from one to the other.

I have seen the orifice of the urethra enlarged by an incision, when treated in this way, heal up, retaining the entire size given to it by the incision. Amussat had recourse to it also, to preserve, after cicatrization, the separation of the tongue from the floor of the mouth, effected by the bistoury. This plan is applicable to all cases where we fear losing the benefit of an incision by the retraction of the cicatrix.

If this new method contains all that it seems to promise, almost all the general rules given for division of cicatrices must be altered. For instance, it was advised—

1. Only to operate on cicatrices perfectly organized, that is to say, some months or even years after their formation, for fear of causing the destruction of the entire cicatrix by inflammation. Evidently this fear is exaggerated, and we may (unless in cases of special indication to the contrary) operate on cicatrices at any time.

2. To make sure, before operating, that we can obtain by means of position or bandages a larger or less deformed cicatrix. Thus the cicatrices of the face were regarded as incurable by this method. We may hope that these restrictions will now fall before experience.

3. To make sure that the return to shape and function is not prevented by any irremediable obstacle, ankylosis, destruction of the muscles and tendons, paralysis, &c. This rule is common to all the methods.

4. In cases of very large and extensive contractions, to perform the operation by degrees, a little at a time, for fear of producing a large wound, which might be followed by serious accidents, and to wait

the cure of a first section before performing a second. Every prudent surgeon should conform to this precept.

5. Finally, the patient, though cured, should continue for a long time the means proper for preventing retraction of the cicatrix; that is to say, apparatus for counter extension, baths, douches, oily and emollient applications, &c. Without wishing to turn aside practitioners from following this precept, I must say that its utility seems to me very conjectural, and I much fear theory has contributed more to its establishment than practice.

(4.) *Abnormal Adhesions.*

Such are the cicatrices uniting the fingers to each other, the penis to the scrotum or to the abdomen, the arm to the trunk, &c. There are three methods.

1. *Ancient Method.*—The adhesions are carefully divided beyond their origin, and each bleeding surface dressed in its whole extent. If we stop here, the cicatrix which forms first at the angle of union of the divided parts, spreading and retracting, would soon produce an adhesion almost equal to that divided; to prevent this a methodical and continued compression on this point is advised. The repeated division of the angle of union practiced by Amussat, as described in the preceding page, has an efficacy differing entirely from that of compression, which latter is generally illusory.

2. *Plan of Rudtorffer.*—It consists in piercing the skin with a trocar at the point at which, in the normal state, the separation of the parts commences, at the base of the fingers, for example; through these holes lead wire is passed, and left in until cicatrization is complete; not till then should it be withdrawn, and the connections divided; dressing as usual.

3. *Autoplastic Methods.*—After having destroyed the adhesions in their entire extent, the skin is slightly dissected on each side, or one side only, so as to unite by first intention. M. Dieffenbach has successfully employed this plan for restoration of the prepuce.

Appreciation.—Autoplasty is undoubtedly the most certain of all our resources, but it is not always applicable; we should say, that if the adhesions consist only of a thin membrane, its separation with the scissors would suffice, and there would not be much danger of its reproduction. M. Amussat's method permits us to extend the benefit of simple sections to divers cases in which they have as yet been useless; as for the plan of Rudtorffer, it requires too much time for the cicatrization, and M. Pétréquin tried to apply it to an adhesion of the eyelids to the eye without any success.

(5.) *Abnormal Obliterations.*

We shall comprise under this head the complete obliteration, and the simple stricture of the natural orifices, such as the vulva, mouth, &c. Many plans have been proposed.

1. *Dilatation.*—By mechanical means, bougies, plates of metal, prepared sponges, &c.

2. *Incision.*—In opening an obliterated or enlarging a constricted

passage, we use, according to the case, a bistoury alone, or, guided on a director, blunt scissors, and a trocar. After the opening is brought to its normal dimensions, mèches, or tubes of ivory made for the purpose a little larger than the natural size, should be introduced and kept in the opening a long time, to counteract the great tendency these openings have to shrink when dilatation ceases. This is the proceeding of Dupuytren; that of Amussat might replace it advantageously.

3. *Method of Boyer*.—It joins compression to the incision, by means of two hooks, drawing the extremities of the orifice in different ways. It is nothing else than the ordinary proceeding for adhesions. It succeeded well in the inventor's hands in a case of partial obliteration of the mouth.

4. *Plan of Rudtorffer*, which requires two holes for the two commissures of the orifice.

5. *The Autoplastic Method of Dieffenbach*, which consists in removing a portion of the integuments and subjacent tissues in all the extent that the natural orifice should have, without touching the mucous membrane; the mucous membrane should then be cut into two flaps, thrown one on each side of the wound, and united to the external skin by suture, &c. It will be more fully described in the article on stricture of the mouth.

Appreciation.—For the small openings, as the nostrils and the auditory canal, the plan of Amussat, or even dilatation, is alone suitable; for large orifices the method of Dieffenbach has an incontestable superiority.

There is a curious analogy between all these proceedings for external strictures and those that have been invented for internal. But these considerations do not come into our plan, and we must be content with referring to the sections that treat of lachrymal fistula, and stricture of the urethra; in them will be found all the points of comparison.

CHAPTER V.

OPERATIONS ON THE MUSCLES AND THEIR DEPENDENCIES.

THE section of a muscle, tendon, or aponeurosis, is performed in case of permanent retraction, resisting all other means.

These operations, very rarely practiced until lately, have had all of a sudden an extraordinary extension. Section of the tendo Achillis, of the sterno-mastoid muscle, of fibrous bands attributed to the palmar aponeurosis, are become common operations; and there are few tendons now which have not been thus treated or advised so to be.

In the head, M. Bonnet has cut the temporal and masseter; in the neck, Gooch cut the platysma in a case of torticollis; Stromeyer

divided the anterior edge of the trapezius ; Dieffenbach has gone as far as the rectus colli muscle : on the back also he divided the rhomboid-eus and latissimus dorsi for a curvature of the spine ; and M. J. Guérin, going farther than either of them, divides the muscles in the vertebral grooves, in cases of curvature of the spine, attributed by him to their contraction.

On the upper limb Dieffenbach cut the supra and infra-spinatus, and latissimus dorsi, to reduce a luxation of two years' standing ; and the biceps for a contraction of this muscle. But it is especially in the lower limb that sections have been multiplied ; J. Guérin cuts almost all the muscles that surround the coxo-femoral articulation, to favour the reduction of congenital luxations.

The tendons of the biceps, semi-tendinosus, semi-membranosus and sartorius, have been divided by MM. Michaelis, Stromeyer, Dieffenbach, and Duval.

It has been advised to cut the quadriceps femoris, for fracture of the patella ; and a modern author goes as far as even to say there are cases where we should cut the ligamentum patellæ.

FOR CLUB-FOOT.—Besides the tendo Achillis, the extensor tendons of the toes, the tibialis anticus, the peronei, the flexors, &c., have been cut ; and in retraction of the toes the tendons of muscles that seem retracted, and the plantar aponeurosis. I say nothing of the section of the muscles of the eye and tongue, they will be treated of elsewhere.

I confess I think a sort of passing fashion has led surgeons a little farther than necessary, or even proper. In the first place, sections of muscles have been made without well marked indication, or with real indications that might have been well fulfilled without operation. There is another question to be decided. When a muscle is divided the fibrous cicatrix diminishes its force, but does not annihilate it ; the same is the case with tendons in a cellular sheath, as the tendo Achillis. But what becomes after their section, of tendons sliding in synovial sheaths ? do they reunite so as to retain the action of their muscles, or is it lost ? Whichever way it may be, I do not like to touch a tendon of this kind unless in a case of well-marked necessity ; and then it would be easy to apply to each tendon the methods of subcutaneous incision, and those we are about to describe.

(1.) *Section of the Sterno-Mastoid.*

The retraction of the sterno-mastoid is the principal cause of torticollis ; M. J. Guérin has showed that ordinarily only its sternal portion is involved ; it forms, in fact, as it were, a particular muscle acting directly on the head, whilst the clavicular portion acts more on the shoulder. I have, indeed, seen a case in which the retraction of this last portion only had the effect of strongly raising the corresponding shoulder.

The section of this muscle was formerly made through a large horizontal or vertical incision of the skin ; now it is done by subcutaneous incision only. It is to Dupuytren that the honour of this operation belongs. In a young girl affected with torticollis he plunged a nar-

row bistoury under the sternal border of the muscle, until the point of the instrument appeared (under the skin) on the outside, and divided the muscle from behind forwards, with only one wound of the skin. More lately M. Stromeyer repeated the operation, but cut the muscle from before backwards; this last method is preferred by J. Guerrin, who modified it, and described the following proceeding:—

Proceeding of M. J. Guérin.—It must be remembered that M. Guérin, in ordinary cases, only operates on the sternal fasciculus of the muscle which he calls the sterno-mastoideus, properly so called.

The patient lying on a bed, the upper third of which is raised in a sloping manner, an assistant holds his head, endeavouring to incline it in an inverse manner to the pathological inclination, and to increase the existing rotation; these two movements are indispensable. The first is to extend the muscle to be divided; the second, still more important, causes it to project forwards and detaches it from the subjacent parts, placing its mastoidean insertion on a plane anterior; a phenomenon sometimes so marked that we may embrace the muscle altogether with the finger and thumb, the skin alone remaining interposed between them. The muscle being thus extended and raised, a fold is made in the skin about three-quarters of an inch above the sternal insertion of the muscle and parallel to its direction, so that the base of the fold when let loose lies over the external border of the muscle. A bistoury, about a quarter to half an inch wide and slightly concave, is plunged into the base of this fold; in the first movement the blade of the instrument is introduced flat, its edge turned towards the head; when it has been passed in about three quarters of an inch, that is to say, so far as to pass the internal border of the muscle, without traversing the skin of the side opposite to the puncture, the edge of the bistoury is turned up in a second movement, and applied to the muscle; in a third movement the fold is let go, and the tendon cut almost spontaneously.

If the two muscles are affected, after having divided the sterno-mastoid, we may divide the cleido-mastoid, inclining and turning the head to the opposite side. The bistoury should be introduced to cut the muscle from before backwards, as we have described; but an essential precaution in this case is to direct the instrument from the inside of the muscle towards the outside.

Appreciation.—Supposing that the contraction is limited to one of the fasciculi of the muscle, which seems to be the most common case, the direction given to the bistoury by M. Guérin is calculated to avoid almost all the dangers of the operation. Thus, in directing the knife from without inwards for the sternal fasciculus we run no risk of wounding the vessels. The external jugular vein is far away outside the course of the instrument. The primitive carotid and internal jugular correspond to the base of the blade, and are, moreover, protected, as well as the tracheal artery, by the sterno-hyoid and thyroïd muscles. The only vessels to fear would be—1. The anterior jugular, which is not constant; and, being subcutaneous, is easily avoided; 2. The inferior thyroïd vein; but it also is protected by

the subjacent muscles, and a wound of it even would be of no importance.

For the clavicular fasciculus, when directing the knife from within outwards, the carotid artery and internal jugular vein covering it, correspond with the base of the instrument, and we have only to fear wounding the external jugular and the horizontal portion of the anterior jugular in its passage to the subclavian vein; but, in making the section at not less than three-fourths of an inch above the clavicle, we avoid the anterior jugular; and, by plunging in the bistoury with its edge perpendicular to the muscle, and not flat, as for the other fasciculus, the external jugular is left between the back of the knife and the skin. I give here the statements of the inventor; but, in fact, his proceeding, though safer than the other with regard to the great vessels, exposes us to the danger of pricking the external jugular.

Another question is, whether it be better to cut the muscle from before backwards, or from behind forwards. For the clavicular fasciculus, the large vessels being so far off, and the external jugular being exposed to the edge of the bistoury passing from behind forwards, the section from before backwards seems somewhat preferable.

But, for the sternal fasciculus, the section from behind forwards seems to me much more safe, if not more easy. M. Guérin rejects it because we are not sure to embrace by the bistoury the whole of the muscle; and a director with difficulty makes a passage through the subjacent fibrous tissues. This difficulty does not exist in the case where the muscle can be so raised as to be grasped between the fingers in a fold of the skin and isolated, in which case the pointed tenotome acts with all possible security. But if, on the contrary, the muscle remained fixed to the subjacent parts, perhaps there would be more danger of wounding the vessels, in cutting from without inwards; and it would be more prudent, in my opinion, to commence by making a wound in the skin, than to plunge through it a blunt-pointed bistoury, and make the section from behind forwards.

There still remains the question as to the spot to be chosen, on which surgeons do not all agree. Boyer fixed it at an inch above the clavicle, others at the inferior third of the muscle, others at its middle, or, again, on a level with its inferior insertions. I had thought there would have been some advantage in performing it as high as possible, the muscle being smaller, and the vessels more distant from the instrument. Another consideration still more confirmed me in this opinion. M. Amussat, in a case of spasm of this muscle, divided it at the union of the middle third with the inferior, but only in four-fifths of its thickness; the patient was cured, but the two superior thirds of the muscle wasted, while the lower third became hypertrophied. The plan I point out was attempted in 1836 by M. Bouvier on a woman twenty years of age, but the patient was so restive that he was obliged to suspend the operation after the incision of the integuments. M. Guérin alleges that in this point we meet too many nerves, which renders the operation very painful. This objection is more applicable to the section of the middle than to that of the upper

part; and we should gain, in my opinion, by preserving this latter, at least in cases where the entire muscle participates in the contraction. We might then introduce the tenotome over or under the muscle, and bring it from before backward, or *vice versâ*, without inconvenience.

(2.) *Section of the Tendo Achillis.*

In some cases of amputation of the foot by Chopart's operation, the foot becomes turned backwards by the predominant action of the soleus and gastrocnemii muscles. It has been advised in these cases to cut the tendo Achillis. This accident happened to a patient on whom I had operated. M. Larrey performed the section with complete success.

It is specially recommended in certain varieties of club-foot, particularly talipes equinus. Put in practice for the first time by Minius in 1685, then forgotten, and resuscitated at the commencement of the present century by Thilenius, and lately by Delpech, it has become in our day a common operation.

Anatomy.—The tendo Achillis, very large above, gradually becomes smaller until it forms a slightly rounded cord, about one inch and a half or two inches above the heel. In adults it again spreads out to be inserted into the calcaneum, from which it is at first separated by a large bursa.

The posterior tibial artery, veins, and nerve, are situated on the inside of the tendon, which a little higher up even covers them, but separated from it by the deep aponeurosis. According to M. Scoutetten, in well marked club-foot, the veins, pathologically distended, describe, as well as the arteries, flexuosities which cause them to occupy a greater extent than they do in the normal state. We may then well be afraid of injuring them, especially in a young subject affected with considerable club-foot; the more so if the tendon be cut at its upper part. On the other hand, in making the incision too low down, we risk opening the bursa. M. Scoutetten lays down the following rule:—

Draw a transverse line, crossing the external malleolus and reaching to the tendon, and you will have the exact height at which the section should be made.

Operations.—The old method consisted in dividing the skin either by a transverse or one or two vertical incisions; but the subcutaneous method alone is now practiced. The proceedings vary according as the section is made from behind forwards, or from before backwards. It is remarkable enough that M. Stromeyer here prefers passing the bistoury under the tendon, whilst he adopts the other method for the sterno-mastoid.

Proceeding of Stromeyer.—The patient is laid on a table, with the affected foot next the side of the operator. An assistant fixes the knee, another grasps the foot, and flexes it, so as to stretch the tendon. The surgeon takes a fistula bistoury, curved and very pointed, and pushes it in at about two to three inches distance above the insertion of the tendon, between it and the tibia, the back of the knife turned

towards the bone, and the edge to the tendon, which, by means of the forced flexion of the foot, offers itself to the knife. The point of the bistoury scarcely passes through the skin on the opposite side to that on which it entered; and in this latter side there is only a wound the size of the width of the blade. The ends of the tendon are brought together by extension of the foot. The cicatrix forms without supuration; and the tenth day the extension of the tendon is commenced.

M. Duval only makes one opening in the skin, which is more simple.

Proceeding of Bouvier.—He uses a lancet and blunt-pointed tenotome. With the lancet he pricks the skin on the side where the tendon offers the greatest projection. Through this puncture he introduces his tenotome between the skin and tendon, and divides it from its cutaneous to its deep surface.

Appreciation.—Here the tendon is so removed from the subjacent parts, especially when extended by flexion of the foot, that the employment of two instruments is superfluous; and that section from without inwards is not dangerous, especially at the point indicated by M. Scoutetten. The operation is, moreover, much simplified by making a vertical fold of skin, the base of which we transfix by the tenotome held flat; then, by turning its edge to the tendon, and flexing the foot, the tendon cuts itself, as it were. M. Scoutetten also recommended plunging in the bistoury on the external side of the tendon, a useful bit of advice, without being always of much importance.

(3.) *Section of the Palmar Aponeurosis.*

Permanent retraction of the fingers, whether congenital or acquired, is frequently owing to a peculiar state of retraction of some fibres of the palmar aponeurosis; at other times to abnormal bands, or even a sort of shrivelling of the skin. In all these cases, the indication is to cut across the bands which retain the fingers flexed, and most frequently affect the ring and little fingers.

Proceeding of Dupuytren.—The hand of the patient being firmly fixed, a transverse incision, ten lines long, is made in the skin, opposite the greatest projection of the constricting band; that is to say, most commonly opposite the metacarpo-phalangeal articulation of each retracted finger, or higher up on the palm of the hand, or lower on the first phalanx, as may be required. The skin having been incised, the finger is reversed, so as to put the band on the stretch, and divide it completely. If, after this section, the return to position is incomplete, another should be made on the same band, at a sufficient distance from the first. Each retracted finger requires a special section. The wounds are dressed with dry lint, and the fingers extended by means of a splint with isolated digitations, fixed on the back of the hand by an appropriate bandage.

Proceeding of Goyrand.—He longitudinally incises the skin on each band, extended beforehand; puts apart the lips of this incision; de-

taches them from the fibrous cords by dissection, and cuts these across when thus isolated.

Proceeding of Sir A. Cooper.—He advises passing under the skin at one side of the cord a narrow bistoury, with which he cuts it, without dividing the skin that covers it.

This method, the earliest in date, and which preceded the analogous plan of Stromeyer for the tendo Achillis, is the simplest and best when the bands are subcutaneous; but when the skin is confounded with them, either by means of cicatrices, or by its own retraction, another method is necessary; and we may choose, according to the case, between that of Goyrand and that of Dupuytren.

(4.) *Vicious Cicatrices of Muscles and Tendons.*

These cicatrices give rise to effects, differing greatly according to their mode of formation. In the forearm, for instance, Dupuytren met with a cicatrix uniting the flexor muscles, after a loss of substance which caused shortness of them, and forced flexion of the fingers. In these cases section of the cicatrix should be made, and the fingers should be extended to obtain another more elongated.

We have seen section of the extensor tendon of the middle finger succeed in this manner, where the contraction turned backwards the first phalanx of this finger and flexed forwards the two others.

Lastly.—We have seen the extensor muscles divided, their extremities separated by the action of the flexors, and a cicatrix arise so as to leave the muscles too long, whence forced flexion followed. M. Dutertre, in a case of this kind, removed all the cicatrix, replaced the fingers by means of a special apparatus, and brought the borders of the skin together, and even the ends of the muscles, by suture. The operation was followed by the happiest result.

CHAPTER VI.

OPERATIONS PERFORMED ON THE NERVOUS SYSTEM AND ITS DEPENDENCIES.

WE shall comprise under this head the operations performed on the cerebro-spinal apparatus for hydrocephalus and hydrorachis, and also the section of nerves in neuralgia.

SECTION I.—CEREBRO-SPINAL APPARATUS.

(1.) *Puncture for Hydrocephalus.*

A very doubtful operation; but, nevertheless, often repeated of late years. Conquest, amongst others, performed it; of nineteen subjects on whom he operated ten were cured, and nine died. It merits attention.

The situation for puncturing has not been sufficiently discussed. Conquest seems to have preferred the course of the frontal suture, in the middle of the space between the cresta galli and the anterior fontanelle. Russel chose one side of this fontanelle itself. Each used a small trocar. Russel plunged it in, to the depth of half an inch. Conquest goes as far as one inch and two-thirds. There is the same disagreement with regard to the quantity of fluid evacuated at each puncture; for instance, from an infant eight months old Russel took away $\text{℥}iii$ of serum the first time; $\text{℥}vi$ the second, a month afterwards; $\text{℥}ix$ eleven days after that; and $\text{℥}ii$ twenty days after that again; the head lost three inches and a quarter in circumference; whilst Conquest removed at once $\text{℥}xv$ $\text{℥}v$; he does not say how much the head was diminished. I had occasion to perform this operation on a little girl eight months old. The examination of the brain of an hydrocephalous child, and of children of the same age, in a normal state, led me to prefer the lateral part of the fronto-parietal suture; there in fact we are nearer the ventricles, and there are fewer vessels to injure. I chose a common trocar, so that nothing might impede the flow of the fluid, and plunged it in about an inch and a quarter; after the first cry caused by the puncture, the infant became unconscious; I drew off $\text{℥}xxxviii$ of liquid without any accident, but a little paleness; four days afterwards, the slight consequent indisposition had completely disappeared. I made a second puncture, and drew off about $\text{℥}xxxvii$, and the accidents again disappeared; but when I was preparing for a third, unfortunately some cerebral disturbances carried off the patient. Notwithstanding the enormous evacuation of liquid and the tender age of the patient, the head did not undergo the diminution in size mentioned by Russel in his patient; and a careful examination of the hitherto published cases leads me to regard his with suspicion. The head in hydrocephalus is soft towards the sinuiput, but hard, and in great part ossified, at the base, and even vault of the cranium; how can the membranes that supply the place of the bones so retract as to lose three and a quarter inches in one direction? It is impossible. In my little patient, the parietal bones, already partly solidified and ossified, approached each other; but the membranes that separated them formed folds very deformed and deep, and which seemed much inclined to persist had she lived. We may, consequently, hinder the ulterior progress of hydrocephalus by puncture, and sometimes even put a definite stop to it; but that is all, the cranium remains almost as voluminous as before. In a case reported by Graefe, concerning an infant of four months, the head was rather more than sixteen inches in circumference before the operation; the patient was cured, it is said, six months afterwards, and the head measured nearly seventeen inches, that is to say, nearly half an inch more than it did before.

(2.) *Puncture of Hydorachis.*

It has been tried once with success by the lancet; a tent of lint was put in the wound to favour the flow of the fluid. Sir Astley Cooper obtained remarkable success by compression, and some one else by

successive punctures with a needle, combined with compression. Perhaps emollient injections, after the method of Recamier, might be advantageously joined to the foregoing plans.

SECTION II.—DIVISION OF NERVES.

The section of nerves should always be accompanied by the removal of a portion of them of greater or less extent, to avoid their cicatrization and a return of the pain.

The general rules are:—

1. Lay bare the trunk of the affected nerve above the origin of all the painful branches.
2. Flex the limb in order to avoid too much dragging the nerve in raising it.
3. Make sure, by raising and irritating the nerve, that it certainly is the one affected.
4. Divide the nerve through at one cut on the one side of its origin, and as high up as the wound will permit; excision may be made afterwards on its inferior end without pain.
5. Excise as much as possible, and generally at least half an inch of the length of the nerve.

These precautions do not assure us against relapse. M. Berard saw a sub-orbital neuralgia return in a woman, from whom he had excised three-eighths of an inch of the affected nerve. Swan observed, in a horse, reunion of the two ends of a nerve, from which he had removed more than an inch. Boyer has, on this account, advised cauterization, an operation that should only be applied to the lower end of the nerve, and that, after it has been divided; even so we are not secured from relapse. After having considered for a long time how to avoid this, it struck me whether we might not succeed better by dissecting the inferior portion of the divided nerve, or both ends if necessary, and bending back each end into the flesh so as to make them form a kind of loop, and oppose their sheath as an obstacle to the transmission of the nervous agency, even after the healing of the wound. Perhaps also we might detach a little bit of raw flesh, and interpose it between the two ends of the nerve to better hinder reunion.

NERVES OF THE FACE.

(1.) *Frontal Nerve.*

The frontal nerve, a continuation of the ophthalmic, divides in the bottom of the orbit, sometimes in the anterior part of it, into two branches, the external and internal frontal. The external, larger than the internal, passes out by the supra orbital foramen, situated about one inch outside the root of the nose, often reduced to a simple bony notch, which may be sometimes felt under the skin on drawing the finger along the supra orbital arch; the other is one-third of an inch more internal: we have only to divide the skin of some fibres of the orbicularis, and the very small arteries that accompany the nerves.

We may incise the skin above or below the eyebrow. We should add that M. Bonnet, of Lyons, rejecting the ordinary method, tried the subcutaneous section, which only makes one incision of the nerve; we shall review his method.

First Proceeding (Velpéau).—The surgeon stands behind the patient's head and raises the eyebrow with his left hand, whilst an assistant draws down the lid; with a straight bistoury, held as a pen, he makes an incision about one inch long down to the bone, starting from the internal orbital process round the arch, but a little above it; the incision should cut the nerve across. The lips of the wound should then be drawn apart, and the upper end of the nerve seized with a dissecting forceps, drawn out, and half an inch of it cut off. The wound should be left open to suppurate for fear of infiltration of pus into the loose cellular tissue of the eyelids.

Second Proceeding.—The incision is made immediately above the eyebrow, or in the line of it, the surgeon stretching the skin with two fingers, without having need of an assistant. Reunion by the first intention has no inconveniences, and the proximity of the eyebrow masks the cicatrix. If necessary, this nerve might be well divided much farther back, by separating the very thin and loose periosteum from the roof of the orbit beneath which it lies. The nerve is known by its whiteness. It is remarkable that these methods have been described as though there was only one branch to be divided. M. Bonnet's method reaches both.

Proceeding of M. Bonnet. Subcutaneous Section.—The patient being seated, the surgeon, with the four last fingers of the left hand, raises the brow and skin of the forehead, causing them to glide on the os frontis so as to stretch the nervous branches, and thus facilitate their section; the puncture of the skin is made with a first instrument in the space between the eyebrows, about half an inch from the mesial line. The tenotome is then introduced horizontally, its edge downwards and pushed outwards, scraping the frontal bone until its point has passed the middle of the superciliary arch; a movement of circumduction is then given to the instrument, its blade being depressed by the elevation of its handle, at the same time that it is withdrawn a little, so as to facilitate the action of the edge during this manœuvre, which is repeatedly executed; care must be taken always to graze the surface of the bone. At the moment the nerve is divided, according to the author, we perceive it by a peculiar sensation of resistance suddenly overcome; a feeling well known to those who have performed subcutaneous sections.

(2.) *Infra-orbital Nerve.*

We may excise it at its exit from the sub-orbital canal, or in the canal itself. In the former case, the incision is made either from the inside of the mouth, to avoid a cicatrix on the face, or directly on the integuments. We should remember that the supra-orbital foramen is situated at the superior part of the canine fossa, about a quarter of an inch below the inferior border of the orbit, in the direction of the first or second small molar tooth, often between them.

First Proceeding.—The upper lip being strongly drawn up, the groove that joins it to the gum is incised for about a quarter of an inch, and by grazing the bone as far as the upper part of the canine fossa, we reach the root of the nerve, which is found in the direction of the second molar tooth, a quarter of an inch below the border of the orbit. Arrived near the nerve, Richerand advises scraping the bone with the bistoury. Velpeau prefers having recourse to straight scissors; but we are operating in the dark, and at best can only divide the nerve, without excising a portion of it.

Second Proceeding.—The patient being seated, the surgeon standing opposite him, makes an incision at the bottom of the naso-jugal fossa about one inch long, starting from the ala nasi; divides the skin; meets the facial vein, which he pushes outwards; separates with a director the fat; the levator labii, which he puts inwards; and the muscles of the canine fossa, which he draws outwards. Arrived at the sub-orbital foramen, he cuts the nerve with the bistoury, and excises as much as possible of its lower extremity. M. Berard, senior, prefers a T incision, whose transverse branch runs along the edge of the orbit. It is well, also, according to his remarks, to divide a portion of the attachment of the levator labii, which hides the nerve at its exit from the suborbital foramen.

The success of the operation may depend a great deal on one circumstance, to which I have called the attention of pathologists. If the pain affects only the cutaneous branches of the nerve, its resection at the orbital foramen suffices; but if the pain extends to all the upper teeth, as the posterior dental nerves are given off deeply from the trunk in the sphenomaxillary fossa, it is probable that the affection extends so far also, and any operation would be useless. Finally, if the anterior dental nerves alone participate in the neuralgia, we may still carry the section above their origin; and for that purpose I have proposed cutting the nerve in its canal. At present I shall restrict myself to the following method:—

Author's Proceeding.—First with a strong tenotome, I penetrate along the floor of the orbit, in the direction of the nerve, which comes out at the infra-orbital foramen, and arrived at two-thirds of an inch in depth, I cut across the floor of the orbit, which is thin, and opposes but slight resistance. Thus the nerve and canal are both divided; then a simple transverse incision, one-third of an inch below the border of the orbit, serves to lay bare the nerve, which may be seized in the forceps, and drawn out from its canal; this may be done without pain, after the previous section. At first I wished to profit by the external incision, to strip the periosteum from the bone and expose the nerve before cutting it; but the isolated subcutaneous section seems much better.

Proceeding of M. Bonnet.—He makes a subcutaneous puncture two-thirds of an inch outside the infra-orbital foramen and the like distance below the border of the orbit. With the left hand the upper lip must be drawn downwards and forwards, so as to stretch the nerve and draw it out from the canine fossa. With the right hand the tenotome is introduced, its edge looking upwards; it should be directed forwards

and a little downwards (care being taken that its point graze the bottom of the canine fossa), and only stopped when it has passed the foramen and rests on the nasal eminence; then turning the edge slightly forwards, the section is made in withdrawing it, as we have described.

(3.) *Facial Nerve.*

Neuralgia of this nerve is excessively rare, and its existence has even been denied by M. Berard, sen^r.; consequently, the occasions for dividing it should also be rare. It may be severed at its exit from the parotid gland; but it has then divided itself into several branches, whose position is by no means fixed, and the operator would only have the direction of the pain to guide him. If we would cut its temporo-facial branch at the spot where it crosses the neck of the condyle of the inferior maxilla in front of the lobe of the ear, a vertical or slightly oblique line should be made from before backwards, starting from the zygomatic arch, and terminating on the posterior border of the jaw above its angle. We should divide successively the cellululo-fatty layer, the aponeurosis, and some thin prolongations of the parotid gland, and lastly the nerve, which is separated from the bone by a little cellular tissue only. We only risk wounding the facial artery, which is easily tied or compressed, but we run a great chance of not finding the nerve sought for.

Béclard, according to Blandin, and after him Velpeau, advise dividing the nerve at its exit from the cranium. The skin is incised vertically for about an inch and a quarter, between the mastoid process and lobule of the ear; the anterior surface of this process and the corresponding border of the sterno-mastoid should be grazed to a depth of half or three-quarters of an inch. The skin and the parotid should be drawn strongly forwards, and at the bottom of the wound, at almost an equal distance from the temporo-maxillary articulation and the summit of the mastoid process, the nerve may be found passing towards the border of the inferior maxilla, obliquely crossing the direction of the wound. We must not forget that at a quarter of an inch at most from the stylo-mastoid foramen, which gives exit to this nerve, and in the direction of the wound, the bistoury would meet the internal jugular vein.

An operation of this kind was performed in America before 1830, on a patient of Dr. Warren. The section of the nerve only paralyzed the muscles of the face, without at all affecting the pain.

(4.) *Inferior Dental Nerve.*

It is divided at its exit from the mental foramen, or before it enters the dental canal.

AT THE MENTAL FORAMEN. *Ordinary Proceeding.*—This foramen is generally to be found in adults below the bony groove separating the alveoli of the canine and small molar, but I have found it sometimes farther back in the aged.—The lower lip is everted, and an incision made opposite the teeth indicated, where the lip joins the gum. At a few lines depth we meet the nerve, which should be cut on the

bone. The cut end projects from the flesh, and is easily recognized by its whiteness. It should be drawn out with a forceps, and a bit removed.

BEFORE IT ENTERS THE DENTAL CANAL. *Proceeding of Dr. Warren.*—This operation was performed on the same patient on whom the section of the facial nerve had been performed in vain.

An incision, extending from the sigmoid notch to the lower border of the inferior maxilla, exposed the parotid gland. Then, by carefully dissecting this and dividing some fibres of the masseter, the operator reached the bone, on which he applied the crown of an inch trepan under the sigmoid notch, and at an equal distance from the anterior and posterior borders of the bone. When the two tables were removed, one with the lever and the other with the forceps, the nerve, artery, and vein were seen at the point where they enter the canal. The nerve was raised on a director, and half an inch of it removed, comprising the origin of the myloid branch; the artery was tied without difficulty. The transverse facial was tied also, at the commencement of the operation. The wound united by first intention, and the patient was cured on the ninth day.

I have seen Velpeau try a good modification of this method on the dead subject. A U shaped incision, passing a quarter of an inch above and behind the inferior posterior border of the maxilla, and rising in front of the masseter, from just outside the facial artery to half an inch below the zygomatic arch, allows a flap to be raised without injuring the parotid gland. The bone laid bare, a middling-sized trepan is applied on the middle of its ramus. The trepan being removed, the nerve is drawn out with it, and cut across above the orifice of the dental canal.

It is important to make sure that the nerve is situated in the thickness of the bone, for immediately at the bottom of the wound is found the lingual nerve, which is of the same size and in the same direction, but passes under the bone and periosteum. It is also a little nearer the superior maxilla. If the trepan is applied too near the anterior edge of the bone, we should only find one nerve, the lingual: the dental must then be sought for behind the circular wound in the bone, and between its two layers.

Appreciation.—The experiments of M. Bonnet oblige us to make a comparison between the above plans and subcutaneous incision. The latter, limited to a pure section of the nerve, seems condemned by the evil results of simple sections made by other methods. But M. Bonnet thinks that after large incisions of the skin, the two ends of the nerve unite by the intermediation of a cicatrix thin enough to re-establish the continuity of innervation; whilst in subcutaneous incision, the blood effused between the ends of the nerve, serves as an intermediate substance, which can well renew its material, but not re-establish its functional continuity. We must say this is only hypothetical; but amongst his observations, there is one concerning a patient seen after seven months without relapse, which seems to prove that simple subcutaneous section has some chance of success. We might then try it, especially on women, for the facial and infra-orbital

nerves. For the mental, M. Bonnet has also given a method; but the ordinary, besides its simplicity and certainty, has the advantage of leaving no visible cicatrix.

In performing the section of the mental nerve last year, I tried to prevent relapse, and put an obstacle to reunion, by dividing the uniting membrane repeatedly at the bottom of the wound, according to the method of M. Amussat. The neuralgia was cured in this part, but returned elsewhere.

In this case the pain seemed to extend so high, that I feared I should be obliged to cut the dental nerve before its entrance into the canal. I confess, then, the methods of Dr. Warren and M. Velpeau seemed to me very harsh, and without abandoning them entirely, they are resources I would only use in extremity. I consequently made, before knowing M. Bonnet's operation, some experiments on the dead subject to see if I could not reach the nerve by a puncture from within the mouth, and the operation succeeded well. I have had no occasion to try it on the patient. It consists in carrying a narrow bistoury, with a blunted point, between the pterygoid muscle and the bone some lines above the level of the dental canal, and cutting the nerve on the bone, sawing with the point of the instrument. But the operation is too delicate to apply before becoming familiarized with all the details of its execution on the dead subject.

NERVES OF THE LIMBS.

A portion of any nerve, accessible to the instrument, may be excised if necessary. We shall only describe the operation most remarkable, on account of the size and importance of the affected nerve.

Sciatic Nerve.

Proceeding of Malagodi.—The patient was laid on his belly. The surgeon at his side extended the integuments with the left thumb and index finger, and commenced at four fingers' breadth above the popliteal space, an incision prolonged from below upwards two inches and a half. The skin and aponeurosis being divided, he reached the interval between the flexor muscles. They were separated partly with the fingers, partly with the handle of the scalpel. The nerve thus uncovered, was then separated from the vessels, the index finger passed under it, and the leg flexed, to allow the nerve to be drawn to the external wound. It was cut with a concave, button-pointed bistoury, and about an inch and a half excised. The wound was united by first intention, and the leg extended. The cure was speedy and all pain disappeared, but there was in place of it, paralysis of the leg and foot, with a sensation of weight and tickling, and an obtuse sensibility in the internal side of the leg.

CHAPTER VII.

OPERATIONS PERFORMED ON VEINS.

IN addition to the different operations for phlebotomy already described, we operate on the veins in two very different cases—1. To obtain their obliteration, whether for the cure of ulcers, varicose or otherwise, or for the treatment of varix.—2. To perform transfusion.

SECTION I.—OF VARIX.

The methods indicated are—*compression, reduction, incision, section, ligature, suture, excision, extirpation, and cauterization*. *Reduction*, advised by J. L. Petit, consists in compressing with the fingers the clots of blood that swell the varices, and thus pushing them into the current of the circulation.

I. COMPRESSION, long since effected by simple bandages, and regarded as purely palliative, has, since the researches made of late years, risen to be one of the most efficacious methods, and includes several very different proceedings.

Proceeding of Delpech.—The vein is laid bare by an incision about an inch in extent. The vessel being dissected and raised, a bit of German tinder, half an inch wide and two long, is placed under it, and secured by two bands of sticking plaster. The wound is then covered with a bit of simple dressing. Of seven cases in which this method was employed, six are said to have been completely cured.

Proceeding of Davat.—The vein is raised in a fold of the skin and a needle passed through the base of the fold, so that the vein rests on the needle. A figure of 8 is then made over the vein, on the two ends of the needle, with waxed thread, as in the twisted suture. M. Davat tried this plan on dogs; on the fifth day the artery was not yet obliterated. M. Velpeau tried it on man, substituting for the figure of 8 circular turns of the thread round the ends of the needle. He says that in twenty-five cases, affected with varix of the limbs, he almost invariably succeeded; the vein was obliterated on the fifth or sixth day.

Proceeding of Sanson.—Imitated from the proceeding of Breschet for varicocele. Sanson used a forceps composed of two oval plates of metal, covered with leather, one inch and a half long, by half an inch wide. From each plate, start at right angles two branches about half an inch wide, which, after passing horizontally half an inch, bend again at a right angle to pass directly upwards, and are almost an inch and a half high. To the middle of one of these vertical branches is fastened a metallic bar, which passes transversely into an opening made on the middle of the other branch, across which it slides easily. Two

screws placed one half an inch above, the other the same distance beneath the transverse bar, and which turn in opposite ways, serve to bring together the two oval plates, destined to seize the vein. The venous trunk to be obliterated, is raised and inclosed between the plates. The situation of the plates must be changed every twenty-four hours for fear of mortification of the skin. The forceps remained on once fifty hours without determining an eschar. The obliteration of the vein may be produced without gangrene being brought on—but an eschar does not impede the cure. M. Bonnet has published three cases of success by this method.

II. **LIGATURE.** *Proceeding adopted by Bécclard.*—The skin being divided to a sufficient extent, a probe, armed with a ligature, is passed under the vessel, which is tied as usual, and cut immediately above. Mr. Wise has proved that the coagulum is formed in forty-two hours after the application of the ligature. He proposes tying it with a running-knot, so that it may be withdrawn after twenty-four or thirty-six hours, when the coagulum is formed. It is probable that the inflammation and suppuration of the vein might thus be avoided.

III. **SUTURE.**—This method, due to Davat, is founded on the physiological fact that primitive adhesion of the internal membrane of veins is very difficult to obtain, unless we produce a slight solution of continuity in it before putting their opposite parietes into contact. He conceived the idea of making a stitch in the vein, by traversing it with a needle, straight or curved, from before backwards, and then from behind forwards, securing the needle with a twisted thread. In this way he operated on a middle-sized dog.—Having raised the left jugular vein with the finger and thumb, he passed under the vein a needle, making it come out through the skin on the opposite side. After seeing that the vein rested on this needle, he took a second, with which he perpendicularly pierced the skin and the anterior and posterior parietes of the vein; then he inclined the needle so as to bring it out a little higher; traversing again the vein and integuments, the needles thus crossed each other; he fastened them with a thread. Five days afterwards, the threads and needles were withdrawn, and the wound healed in three hours; the vein was solidly obliterated. The obliteration commenced after thirty-eight hours, but at that time it was not strong enough to resist the effort of the blood.

This proceeding has not yet been tried on man.

Proceeding of Fricke.—It consists in traversing the vein from side to side, and from before backwards, then returning from behind forwards, and leaving the thread in the vein as a seton, for some days; this suffices to determine the formation of a coagulum and the obliteration of the vein. Fricke wrote to Velpeau that he had applied this method in thirty cases with success. Velpeau tried it twice, but traversed the vein several times. The two patients were attacked with violent phlegmonous inflammation. If we would try this plan, then, we should only use the one loop, as Fricke.

IV. **INCISION.**—We first place two ligatures round the limb, the first above, the second below the point where we wish to open the vein; then, if it adheres to the skin, we open both with one stroke of the

lancet, making an opening double as large as that for phlebotomy. If it is free, we retain it with the fingers, so that the incision may be parallel to that of the skin. Ordinarily several incisions must be made, one at a distance from the other, so as to completely empty the vein of all clots. The wounds are then united, and a compressing bandage applied.

V. SECTION. *Ordinary Proceeding*.—The vein is cut across with a scalpel, or raised in a fold of skin and divided by a bistoury passed through the base, and made to cut out—the result is the same. All the varicose trunks being thus cut, the wound is filled with lint; the suppuration that follows brings on obliteration of the vessels.

Proceeding of Brodie.—He uses a slightly concave bistoury, with a narrow blade and sharp point. This he pushes, flat, under the integuments between the skin and vein, then by turning the edge backwards, and pressing as it is drawn out, the vein is cut through without enlarging the little wound.

It was hoped by this plan to avoid the entrance of air—the presumed cause of phlebitis—but Bécлар saw phlebitis and erysipelas follow this method, which, moreover, exposes us to the danger of not completely dividing the vein, and failing in its obliteration. The first proceeding seemed to him the best.

Proceeding of Richerand.—He incises parallelly to the limb, across the tortuosities and varicose sacs, with a scalpel which penetrates to the aponeurosis; the part of the limb should be chosen where there are most varices collected together. The incisions are from three, four, or five, to seven inches in extent; the clots are pressed out, and the wound filled with lint. At the end of three or four days the dressing is removed and the venous orifices are found to be stopped up.

VI. RESECTION.—A fold is made in the skin across the vein, and incised. A director is then passed under the vein, on which it is divided at the bottom of the wound; the upper extremity of it is then drawn out and cut off, so that the two ends retract under the skin and are not in contact with the air.

The ancients cut the vein across between two ligatures.

VII. EXCISION.—It is only employed in the present day for large varicose clusters in the legs, or for varices whose position renders them troublesome or deformed. If the skin is healthy, it is incised in a fold, and all the varices that should be removed are dissected out. If it is adherent, an elliptical incision is made in the skin, and the flap of skin removed with the varices.

VIII. CAUTERIZATION.—The ancients employed fire. M. Bonnet of Lyons applies caustic potash, on different points of the varicose vein, to obtain its obliteration in many places; M. A. Bérard prefers the *pâte de Vienne*.

Appreciation.—Of all these plans there are only four, viz. incision, section by the ordinary proceeding, the proceeding of Richerand, and excision, that are performed on the region and diseased part of the vein itself; the others are performed more especially, on a sound part of the vessel, between the varices and the heart. Their efficacy must be examined under two points of view: the obliteration of the vessel,

which always causes (temporary at least) obliteration of the varices ; and definite cure. For obliteration of the vessel, the plans performed between the varices and heart deserve preference. The choice between them is difficult ; perhaps even the temporary ligature of Mr. Wise would be less subject to the dangers common to them all. But a radical cure cannot be insured ; to those obliterated, succeed others, or even the limb becomes œdematous. It is now well known that by ligature, suture, incision, &c., we only obtain a temporary obliteration ; the blood resumes its course even in the vessels that were obliterated ; this phenomenon is not so frequent in obliterations by caustic, on which account it has the preference.

We should add that not one of these methods is exempt from danger ; cauterization seems also the least dangerous, but yet M. A. Bérard saw it once determine a mortal phlebitis. For varicose tumours you may choose according to the case, between the proceeding of Riche-
rand, and excision.

SECTION II.—TRANSFUSION OF BLOOD.

Received most enthusiastically in the seventeenth century, afterwards fallen into oblivion, it is now only employed in certain cases of serious hemorrhage. Formerly the blood of animals was transfused into man, now human blood only is used.

Proceeding of Lower.—He dissected the carotid of a dog or some other animal, disengaging it to the extent of an inch, and tied a firm ligature on its upper part ; about an inch below he applied another ligature with a running knot, loosened at pleasure ; two threads being passed underneath the artery, it was then opened, and a tube or bit of a quill was introduced into the opening, and solidly fastened in the artery by means of these two threads. The jugular vein of another dog was also uncovered to the extent of one inch and a half, and at each angle of the incision a ligature with a running knot was made ; two threads were passed under it and an opening made, in which were fixed two tubes, one to receive and carry to the heart the blood transfused ; the other to direct into a basin the blood returning from the head.

The dogs being then laid near each other, so that the tubes might meet, the arterial tube was introduced into the venous, or, if necessary, made to communicate by other intermediate tubes ; then, the running knots being removed, the blood from the artery of one dog flowed into the veins of the other : at the same time, to prevent engorgement, as the second dog receives too much blood, he is made to lose an equivalent quantity from the upper end of the jugular ; care must be taken, if the tubes become clogged, to disengage them, and re-establish a free passage with a director. It is plain that in applying this method to a man exhausted by hemorrhage, we might choose another vein and tie the capillary end of the vessel, as there is no need of letting the blood flow. The bits of quill may be replaced by metallic tubes, as in the following method.

Proceeding of King.—He used a silver tube with a director of the same metal, blunted at one end, and flattened at the other to be more

easily handled; a bandage is applied on the arm of the person who should receive the blood, as if for bleeding; if the vein is large, and superficial, it may be opened with the lancet; if not, a fold should be made in the skin, and divided with the bistoury, as in making an issue. The vein uncovered, is now to be opened to a sufficient extent. The finger of an assistant, or a small compress, should be put on its lower end to prevent the blood from flowing up it; the tube is introduced into the upper end of the vein with its director to facilitate its entrance; when *in situ* it is retained by the finger and thumb pressed on the skin; the director is then withdrawn, another tube placed in the same manner in the artery of an animal is then insinuated into its open end, and the bandage placed above the opening in the vein removed; the arterial blood of the animal then passes without obstacle into the vein of the man.

This method might in like manner be applied in transfusion of human blood, by placing the second tube in the lower end of a vein; we need only fear lest air contained in the tubes be driven into the veins of the patient, and arrive at the heart; but it seems that King did not meet with these accidents in his experiments.

Modern Proceeding.—It is preferred now, to receive the blood in a syringe plunged in water, kept at the temperature of the blood, 32° Reaumur.* The veins of the arm of two individuals are made to swell by the application of a bandage as in ordinary bleeding; the largest vein in the arm of the patient is uncovered by a careful dissection, and opened longitudinally; a compress being put on below, to hinder the blood from flowing, a metallic canula, or the end of an elastic catheter, perfectly fitting to the tube of the syringe, is introduced into the opening of the vein, and the bandage removed; the healthy individual is then bled. We receive first about 5 oz. of blood in the syringe, and commence by injecting this quantity without losing time, or the blood will coagulate, pressing gently on the piston so as not to occasion a great shock to the vessels or heart of the patient. The passage of the blood is facilitated by pressing gently on the course of the receiving vein from below upwards. Generally the injection of 5 or 6 oz. is sufficient to remove all fear of death by loss of blood; if we judge that more is wanted, a second quantity may be injected with the same or another syringe.

There are two dangers in this operation: the first is the entrance of air, which does not seem to have been yet met with, though foreseen theoretically; the second is the coagulation of the blood either from excess of heat, or by cooling. In general the blood of limbs not being above the temperature of 77° or 90° F., perhaps it were as well not to raise the temperature of the syringe higher. There is much yet to be done before all the necessary security is given to transfusion.

With regard to the injection of medicated substances into the veins: we shall only say—that the vessel should be prepared as for transfusion, and the fluid heated to from 26° to 32° R. (90° to 104° F.)

* (104° Fahr.) This exceeds the estimate of Magendie, Thompson, and Müller. The latter gives it at from 100 $\frac{2}{3}$ ° to 101 $\frac{3}{4}$ °.

CHAPTER VIII.

OPERATIONS PERFORMED ON ARTERIES.

WE shall treat in the first place, of the operations comprised under the general term *Ligature of Arteries*, and shall afterwards pass in review the special proceedings required by wounds of these vessels, and aneurisms.

SECTION I.—LIGATURES OF ARTERIES.

Lately, M. Tavignot has proposed a series of plans for tying arteries without dividing the skin, constituting *subcutaneous ligature*; but this project has as yet remained theoretical, and I doubt if it will ever pass into practice. Consequently, we shall only describe the ordinary methods, whose object is to lay bare the artery, and more or less isolate it from the surrounding tissue, in order to allow a ligature to be put round it. It will be seen that the same proceedings serve also for performing torsion, crushing, &c.

OF LIGATURE OF ARTERIES GENERALLY.—It must be remembered that arteries, composed of three tunics, are, in addition, surrounded by a special cellular sheath, generally placed under the aponeurosis, and accompanied by veins and nerves.

The general rules of ligature affect three objects: 1. Uncovering the artery. 2. Isolating it. 3. Placing a ligature round it.

TO LAY BARE THE ARTERY.—In the first editions of this book, I followed especially the rules laid down by M. Lisfranc, and which are, for the most part, applicable as well on the dead body as the patient. I shall repeat them, with the addition of such restrictions and modifications as experience has taught me to think necessary.

1. We make ourselves sure of the position of the artery on the subject by a knowledge of its anatomical relations, by causing the muscles that bound it to contract, and by figuring lines which mark its direction. On the patient we may add another indication, which consists in recognizing the vessel by its pulsations. This is the only way of finding an artery that deviates from its normal course.

2. The artery recognized, M. Lisfranc advises marking, with the four fingers of the left hand placed perpendicularly on the skin, the direction and extent the incision should have. The skin, he thinks, is also properly stretched by this proceeding.—It seems to me that it very badly extends the skin, and especially has the serious inconvenience of drawing it from the true situation of the artery, which puts the operator in doubt as to the precise point for the application of the knife; consequently I extend the skin in the ordinary manner, so that its agreement with the direction of the vessel may be in no way altered.

3. When the artery is superficial, and perceptible to the touch, the incision may be made parallel to its direction; when deep, it is better that the incision cross it rather obliquely; there is then less risk of our falling on one side of it.

4. The skin divided—if the artery lies immediately under the aponeurosis, the latter should be opened at the side of the vessel, to avoid wounding it.

5. If the artery is deep, the muscles should be made to contract, that we may better see their interstices. They may be separated with the finger, director, or handle of the knife, and should be raised on the least shelving side of the wound, to diminish the depth of the opposite side. For example, in tying the femoral artery in the middle of the thigh, the internal border of the sartorius should be elevated. The muscles must only be cut when we cannot put them aside.

6. If we are put out in our incision, anatomy, well studied, offers some certain marks to set us right. For instance, the sartorius in the middle of the thigh conceals the artery under its internal border; the subclavian is at the external side of the tubercle of the first rib, &c.

7. Having reached the artery, the surgeon recognizes it: in the subject by its dull white colour, by its being thicker than the vein, and by its relations; in the patient he may also recognize it, by its flatness when compressed on the side next the heart, and by its pulsation when this compression does not exist.

These seven first rules are applicable to all the modes of operation, but do not establish any general method to which each special proceeding is subject. I have tried to found something of this kind, based on the following considerations:—

However superficial an artery, two incisions are always necessary to uncover it—an incision of the skin, and an incision of the aponeurosis, and often more.

If immediately after the first incision the surgeon attempts to find the artery, he tries an impossibility, since he cannot reach it till after the last incision. He will then proceed uncertainly, and at random. On the contrary, each incision should have a positive object, so that in any step of the operation, the surgeon knows where he is, what progress he has made, what he has to make, and the shortest way to make it.

Whence the following, which I call the rule of the guiding points:—

The surgeon should not at the commencement occupy himself with looking for the artery, but should seek the first marked point of guidance, then the second, then the third, if there be one, and so on to the vessel.

TO ISOLATE THE ARTERY.—1. If the artery is small, or yellow, which indicates an alteration of its tunic, its sheath should not be opened. This is seen by putting a bit of sponge dipped in cold water in the wound, and leaving it there some minutes, to stop the bleeding.

2. To open the sheath. It may be seized with a dissecting forceps,

and a bit cut out of it with the bistoury; but the safest plan is to tear its fibres with a director or the nail. The artery should be exposed in the smallest possible extent.*

3. The director is then passed under the artery, held as a pen, so that the middle finger lies along the end of the instrument; for arteries rather deep, the end of the director must be curved; for those not easily reached, we use the needle of Deschamps.

4. In general, if the vessels are small, and there is a collateral nerve, we introduce the director between the artery and nerve. If there is only a vein, between the artery and vein—in fact, the greatest resistance is at the point at which the director should be brought out; and, by neglecting the principle indicated, we risk bruising the nerve or tearing the vein; but if the vein is large, its lesion being very serious the sound must be passed between it and the artery.

5. When the artery is large—the crural, for instance—it moves before the director, or flattens before it, and may be sometimes traversed through and through. To avoid this danger, it should be fixed with the finger and thumb, a little above and below the point where the director penetrates.

6. If the director has raised important parts with the artery, the artery may be isolated with another director, and then the first withdrawn; but if only small veins or nervous threads are concerned, it is not worth while.

7. The artery seized, and put on the director, make sure of its pulsation to avoid any mistake. In doubtful cases, after having placed the ligature, we may incise the vessel slightly and gently; we shall then recognize by its texture whether it be artery or nerve. With regard to the veins, their colour prevents mistake.

PLACING THE LIGATURE.—1. To place the ligature under the artery, a probe armed with the thread is conducted on the director, and the instrument disengaged, leaving the thread. If we use the needle of Deschamps, which has its eye near its extremity, as soon as this extremity appears on the other side of the artery, the thread may be disengaged, and the needle withdrawn by the same road as it entered.

2. The ligature must compress the artery perpendicularly. If it were placed obliquely, it might slip, and not compress enough.

3. The limb is afterwards so placed, that the pus may flow easily, and the muscles be in a state of moderate relaxation, without the lips of the wound being too much separated.

The choice of ligature, the different modes of applying it, etc., are treated of in the chapter on the means of preventing effusion of

* The instruments that may be required, and should be at hand, are a small scalpel or two; good dissecting forceps; two copper spatulæ, each about one inch broad; a slightly curved aneurism needle, well blunted, and with a round opening close to the point, sufficient only to receive the ligature of strong stay-silk or thread with which it is armed; and a few suture needles to complete the apparatus. Sponges and lint are not to be forgotten. A director is omitted, as being very useless, and what is worse, its employment being likely to lead to mischievous laceration of the tissues and disturbance of the vessel from its connections; neither is that absurd tool, a blunt silver knife—another refuge of nervous and unskilful operators—admissible into the apparatus of a good surgeon.—Liston, p. 187.

blood. (Chap. IV. p. 54.) We shall complete this subject in the article on aneurisms.

OF LIGATURES OF PARTICULAR ARTERIES.

We shall go through the arteries from the periphery to the centre, beginning with the superior aortic system.

(1.) *Superior Aortic System.*—*Ligature of the Radial Artery.*

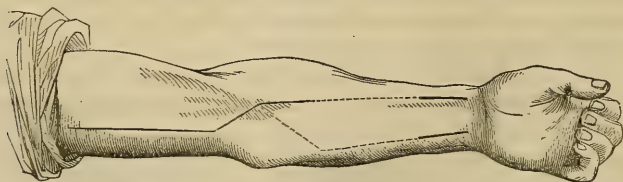
It may be laid bare in three situations—

I. ON THE DORSUM OF THE WRIST.—By strongly extending the thumb we cause the tendons of the abductor longus (extensor ossis metacarpi pollicis), and extensor longus pollicis (extensor secundi internodii pollicis), to be prominent. In the depression between them, commonly called "*La tabatière*," we may perceive the pulsation of the radial artery.—The thumb being separated from the index finger, an incision is made about an inch in length in the direction of these tendons; some nervous and venous branches are put aside, and the artery isolated with a director. This is a method of the dissecting-room only.

II. IN THE LOWER THIRD OF THE FOREARM.—The artery, perceptible to the touch, is only covered by the aponeurosis and skin. It is accompanied by two veins; the radial nerve is far outside of it; the tendon of the flexor carpi radialis running along its inner side would be the guide had we not its pulsation. An incision is made from half an inch above the radio-carpal articulation, one and a-half or two inches long, on the radial side of the tendon of the flexor carpi radialis. The first incision should lay bare the aponeurosis and prominence of this tendon; the second divides the aponeurosis, and at the radial side of the tendon, we certainly find the artery, under which a director is passed from without inwards, or *vice versâ* indifferently.

III. ON THE UPPER THIRD OF THE FOREARM, the artery passes in a groove that separates the supinator longus from the pronator radii teres and flexor carpi radialis, covered by the internal border of the first, by the aponeurosis and skin. It has always two satellite veins,

Fig. 2.



Situation for ligature of the Brachial, Radial, and Ulnar Arteries. The dotted lines show where the vessels are more deeply seated.

and the radial nerve on its outside. Its course is exactly marked by a line drawn from the middle of the bend of the elbow to the middle of the space that separates the styloid process of the radius from the tendon

of the flexor carpi radialis. Roux makes an incision two inches long in the direction of this line, at least five-eighths of an inch from the articulation of the elbow. If the median vein presents itself it is put aside; the aponeurosis is cut on the director; the border of the supinator longus is put aside without being cut; the artery is exposed; and the director is passed from without inwards to avoid the nerve.

Marjolin follows the artery from below upwards with the fingers, makes the supinator longus contract, and cuts along its internal border.

These proceedings are good for thin individuals, or those with very well-marked muscular interstices. In subjects loaded with fat, the artery cannot be thus followed; and the plan of M. Roux exposes us to the danger of wounding the median vein, and falling too much inside the supinator longus, which hinders us from conveniently turning the edge of this muscle outwards. Whence the following:—

Proceeding of Lisfranc.—Half an inch outside the middle of the elbow, he marks the starting point of an imaginary line, which two inches and a-half below would fall on the outer side of the forearm. He incises the skin in this line, and seeks the muscular interstice on the inside of it. But in its turn, this plan risks our falling too much outside the interstice of the supinator longus.

Proceeding of the Author.—The incision should be made in the course of a line drawn from the point of departure, noted by M. Lisfranc, to the middle of the space separating the styloid process from the tendon of the flexor carpi radialis. The first incision divides the skin, and the operator should then see if the median vein lies to the inner or outer side, so as to avoid it. The second incision should lay bare the supinator longus. Having proceeded so far, the surgeon raises its internal border with his finger or the director; he then has under his eyes the fibrous layer that constitutes the posterior part of its sheath. Sometimes this layer is so thin that the artery appears through it; at others, it must be divided first. If the artery is not found on a level with the internal border of the supinator longus, or, sometimes more external to it, the muscle must be turned out until the radial nerve be seen—a white cord that is never absent and constitutes the last guiding point. Explore the cellular tissue between this nerve and the median line, and you will certainly find the artery, or you may safely assert that it is an anomalous distribution.

(2.) *Ligature of the Ulnar Artery.*

Its course is marked superiorly by a line, which, from the middle of the elbow, would fall on the internal border of the ulna, at the union of its upper with its middle third: and, for the rest of its extent, by a line drawn from the internal tuberosity of the humerus to the external side of the pisiform bone; we may tie it in several places.

I. AT THE WRIST.—It runs along the radial edge of the pisiform bone, having the ulnar nerve on its inside, and a vein on each side. A longitudinal incision is made in this point an inch and a-half long, successively dividing the skin, adipose tissue, and palmar aponeurosis. We then reach the artery, and pass the director from within outwards.

After the first incision, a number of fatty globules escape from their fibrous cells and entirely fill the wound. All that hinders the progress of the operation must be removed with the scissors. (Method of the operating school only.)

II. IN THE LOWER THIRD OF THE FOREARM.—It lies on the flexor profundus, covered by the very thin deep aponeurosis, by the external border of the tendon of the flexor carpi ulnaris, and lastly by the aponeurosis and skin. The tendon of the flexor carpi ulnaris is here the essential guide.

An incision, about two inches long, is made, beginning an inch above the crease in the skin at the wrist, in the direction of the artery, along the edge of the tendon of the flexor carpi ulnaris. The first incision should lay bare the superficial aponeurosis; the second the external border of the tendon of the flexor ulnaris; by pulling the tendon a little inwards, we perceive at its external side, the artery with its veins still covered by the second aponeurosis. The ulnar nerve is on the inside, and a little behind. The artery is isolated, and the aponeurosis divided. The director is passed from within outwards.

III. IN THE MIDDLE OF THE FOREARM.—As far as the union of the upper quarter with the lower three-fourths of the ulna, the artery is found lying on the flexor profundus, but covered by the flexor carpi ulnaris and the flexor sublimis conjointly.

We may then make, at this point, an incision at least two inches and three quarters long in the direction indicated, which in no case should pass higher than three fingers' breadths below the tuberosity of the humerus. The first incision should expose the superficial fascia; the second falls on an aponeurotic line joining the flexor carpi ulnaris and flexor sublimis, recognizable by its yellowish-white colour. The incision, made exactly in the direction pointed out, always falls upon this line. But if we fear to be mistaken, we have the resource indicated by M. Lisfranc, viz: to carry the internal lip of the wound inwards until the finger feels the internal border of the ulna. The first muscular interstice met with outside this bone is the one that must be opened.

This interstice may be destroyed with the finger or director, or with the knife (when the muscles are united by a common aponeurosis, always begin at the lower part, where they are least adherent), then the flexor sublimis is turned outwards, and the deep aponeurosis is seen, under which is the artery with its two veins, and the nerve, which is at some distance from it superiorly, shows itself. If the artery cannot be seen, the flexor carpi ulnaris should be turned in, to discover the ulnar nerve. This last guide found, we see the artery some lines internal to it, or it is anomalous. It should be raised from within outwards, either with a curved director, or a blunt needle mounted in a handle; to isolate it more easily, the forearm should be gently, the hand strongly, flexed.

IV. AT ITS SUPERIOR PART.—Performed once by M. Marjolin, but in the present day generally rejected on account of its difficulty.

(3.) *Ligature of the Brachial Artery.*

It may be felt all the way up, and nearly follows the internal bor-

der of the coraco-brachialis and biceps; this last muscle even covers it slightly inferiorly when the forearm is pronated, whence the precept always to put it in a state of supination to discover the artery. It is tied at the bend of the arm, or at its middle or upper part.

I. AT THE BEND OF THE ARM.—Its course is marked out by a line which passes up obliquely inwards towards the internal edge of the biceps. It would also be well enough indicated by the median basilic vein,* which runs under the skin almost parallel to the artery; but it is better, in all cases, to cause the biceps to contract and make its tendon prominent. This tendon is the essential guide, since we are sure to find the artery on its internal side.

An incision two inches in length is made along the internal edge of the tendon of the biceps, inside the median basilic vein. The first stroke of the knife divides the skin; then carefully lay bare and put aside this vein; the second divides the aponeurosis, thickened by the tendinous expansion of the biceps, and is intended to lay bare the tendon itself. When the tendon is seen, observe its internal edge and you will perceive the artery, accompanied on each side by a satellite vein, with the median nerve a quarter or half an inch inside it. The forearm should be flexed a little, to facilitate the isolation of the artery, and a director passed under it from within outwards.

If the incision be made a little higher than the elbow, we should remember that the median nerve passes underneath the artery about two inches above the epitrochlea, so that it is superiorly, on its anterior external side.

II. IN THE MIDDLE AND UPPER PART OF THE ARM.—It lies, above, on the inside of the coraco-brachialis; lower down, on the inner side of the biceps, which even covers it a little in very muscular subjects. The median nerve lies along the external and anterior side of the artery. Four indications serve to mark the situation of the external incision: 1. Directing it along the internal edge of the biceps, and higher up; of the coraco-brachialis (Hodgson); 2. Following a line drawn from the middle of the axilla to a little inside the middle of the bend of the elbow (Sabatier); 3. Placing on the course of the median nerve the four fingers of the left hand, and incising on the inside of it (Lisfranc); 4. Following the direction of the pulsations of the artery. The last is certainly the best in the living subject.

The skin should be divided along the internal border of the biceps to the extent of two inches. The first stroke of the knife should expose the fascia, the second uncovers the biceps near its inner border, which is the first point of guidance. Without displacing the muscle, a fibrous layer, constituting a portion of its sheath, and which separates it from the nerves and vessels, should be incised along its internal edge. This incision should expose the median nerve—the first white large cord met with inside the muscle. This is the second point of guidance; in fact, in putting it slightly to the outside, the artery is infallibly found beneath, and inside it. The artery is accompanied by its two satellite veins, and also internally by the inter-

* See Fig. 1, *b*, p. 70.

nal cutaneous nerve, and half an inch behind, by the ulnar. The sheath of the artery is divided, and the director passed under it from without inwards. In the upper third of the arm the artery is at the internal border of the coraco-brachialis; care must be taken, then, not to allow yourselves to be misled by the projection of the internal edge of the biceps.

(4.) *Ligature of the Axillary Artery.*

We comprise under this term, the portion of the arterial trunk extending from the inferior border of the first rib to the level of the anterior border of the axilla. It is tied in three different places.

I. **IN THE AXILLA.** *Proceeding of Lisfranc.*—The patient is laid on his back, his arm well raised. In this position the course of the artery, perceptible under the skin, is marked by a longitudinal line separating the anterior from the middle third of the axilla.

An incision, two inches long, which only divides the skin, is made in this direction. The fascia is then divided on a director. If a simple incision does not allow a sufficiently free opening, the fascia may be divided to the right and left, and we then fall on the nerves and vessels. The bistoury is now abandoned for the director, and the arm slightly lowered to relax the tissues. The first object that presents itself is the axillary vein. An assistant pushes it backwards. Then the nerves of the brachial plexus. The operator raising the anterior border of the wound, recognizes the coraco-brachialis, and inside it the median nerve; inside it again, the internal cutaneous, and more posteriorly the ulnar and radial. The first two are put aside, and under the median we find the artery, beneath which we pass a director from behind forwards. As there are nerves on every side, we at all events avoid injuring the vein.

It is of great importance that the external incision be made as we have said, or what answers the same purpose, at three-fourths of an inch from the anterior border of the axilla (Manec), and that the search for the nerves begins from the coraco-brachialis, otherwise we might mistake the radial or ulnar for the median, and uselessly search for the artery beneath it; consequently I have modified the preceding indications, and perform the operation as follows:—

The first incision, made in the manner pointed out, should expose the fascia; the second, the internal border of the coraco-brachialis: first indication; the third incision, dividing the sheath of this muscle on a level with its internal border, conducts us directly on the median nerve: second indication; on the inside, and beneath which we inevitably find the artery.

II. **BENEATH THE PECTORALIS MINOR.**—Desault imagined a plan of incising along the interstice that separates the deltoid from the pectoralis major, separating these muscles, and tying the artery under the pectoralis minor.

This is the operation as modified by Delpech:—

Lay the patient on his back, with his arm separated from his body at an angle of 45° ; make an incision through the integuments, two inches and a half long, commencing beneath the clavicle at the union

of its external with its middle third, and descending obliquely towards the humerus in the direction of the interstice mentioned. Separate and strongly draw apart the two muscles, and the pectoralis minor is exposed; divide it completely near its insertion into the scapula. Then carry the index finger to the bottom of the wound, and follow the surface of the serratus magnus until stopped by the scapula; then bring back the finger bent, passing it between the subscapularis and the entire mass of vessels and nerves, and raise them on it to the surface of the wound. The artery is seen at once, exposed immediately before it passes between the roots of the median, having the vein on its internal side, and almost all the plexus on its outside. It is easy to pass a director under it, or the needle of Deschamps.

In this operation we risk injuring the branches of the superior thoracic artery, which run along the upper border of the pectoralis minor to spread out on the internal surface of the great pectoral and deltoid; but they are easily recognized and isolated, so as to be tied even before they are divided.

III. UNDER THE CLAVICLE.—The artery is here found in a triangular space, bounded above by the clavicle, below and on the outside by the pectoralis minor, below and on the inside by the sternal portion of the pectoralis major.

Ordinary Proceeding.—Lay the patient on his back, the shoulder slightly raised, the elbow a little removed from the body, so as to stretch the skin and allow you to act on a point more elevated than the artery. Make an incision three inches long, three-quarters of an inch below the clavicle, and parallel to this bone, terminating outside the union of the pectoralis major and deltoid.* After the skin, divide layer by layer the platysma and pectoralis major; then on a director, the posterior portion of the sheath of this muscle, which sometimes has the aspect of an aponeurosis, and doubles back to envelope the pectoralis minor. Then bring the arm to the body, and resign the knife for the director, with the end of which tear aside the cellular tissue covering the vessels; carry the bent finger behind the upper border of the pectoralis minor, to push it downwards and outwards, and you see successively, 1. On the inside, the axillary vein swollen with blood at each expiration, and partly covering the artery. 2. Outside and a little behind, the artery itself. 3. More externally, and behind again, the nerves of the brachial plexus. It is especially necessary to avoid the vein: it should then be drawn inwards by an assistant with a blunt hook, and the director passed between it and the artery from within outwards.

This ligature is one of the most difficult to place on the patient. We have seen Dupuytren obliged to tie twelve or thirteen small arteries before reaching the vessel. The operation lasted nearly forty minutes.

It is recommended to place the ligature above the origin of the acromial and thoracic arteries, whose propinquity would hinder the formation of a coagulum. Another very important care is to avoid the cephalic vein, both in incising the pectoralis major, along whose

* Fig 3, a, page 149.

external border it passes, and in passing the director under the artery, which it crosses to reach the axillary vein.

Plan of Lisfranc.—It consists in giving an oblique direction downwards and outwards to the incision, following the interstice that separates the clavicular from the sternal portion of the pectoralis major. The arm is strongly abducted, to render this depression more apparent. The skin being incised, the two portions of the muscle are drawn apart with the finger or director; the arm is then brought to the trunk, and the remainder of the operation performed as in the preceding. This plan has the advantage of not dividing the muscular fibres; it is said to have the fault of not exposing the artery high enough up, and of rendering the operation more difficult. On the living subject it is to be feared lest the contraction of the great pectoral stop the flow of the pus, and occasion sinuses in the axilla. I give the preference to the first proceeding; but as I have more than once seen one of the nerves taken for the artery, and *vice versâ*, I give this precept: When the posterior part of the sheath of the pectoralis major is divided, search in the inside of the wound; the first thing met with is the vein. This is an infallible landmark. Carrying it inwards, you find the artery outside and a little behind. It is impossible to confound it with the nerves, which we have no need to examine.

(5.) *Ligature of the Subclavian.*

It may be laid bare and tied in three different situations.

I. ON THE FIRST RIB.—The artery is here found in the omo-clavicular triangle, bounded above and outside by the omo-hyoid, inside by the anterior scalenus, below by the clavicle. Coming out from under the scaleni, it descends to the first rib, which affords it a groove, outside the insertion of the scalenus anticus muscle; to the outside and a little above, it is in contact with the brachial plexus; below and on the inside with the vein, from which the scalenus anticus separates it. It corresponds externally to the hollow above the clavicle. To lay it bare, we must divide—1. The skin and subcutaneous cellular tissue. 2. The very thin cervical fascia, and the platysma. 3. The deep cervical fascia. 4. Lastly, the cellular tissue full of venous branches and lymphatic ganglions, and in which run two important arteries, the cervicalis transversalis placed some lines above the subclavian, and the superior scapular, which runs along the posterior border of the clavicle. Sometimes the sterno-mastoid muscle, being inserted very widely into the clavicle, must be partly divided. Sometimes also the external jugular vein, thrown outwards more than usual, requires to be avoided.

In subjects with short necks, the first rib is found lower in relation to the clavicle, and the artery is very deep and difficult to find. The contrary happens in those with long necks. But the anatomical relation most essential to know is the presence of a more or less projecting tubercle on the first rib, which gives attachment to the anterior scalenus. The artery is invariably on the outside of this tubercle.

Proceeding of M. Lisfranc.—The patient, seated or lying down, with his head secured, his shoulder drawn downwards and slightly

forwards, make an incision immediately above the clavicle, parallel to its posterior border, commencing one inch outside the sternal end of this bone and extending to the insertion of the trapezius muscle. Divide the skin cautiously, and if the external jugular vein show itself, seize it with a blunt hook, and let it be drawn inwards by an assistant; after which cut across the platysma with its two cellular lamellæ; and lastly the cervical fascia almost confounded with the deep layer of the platysma. Then give up the knife. Tear the cellular tissue with the nail or point of the director and carry the index finger into the internal angle of the wound to find the tubercle of the first rib. This point found, the artery is easily met with on its external side. The nail remains on the tubercle, and serves as a guide either for the curved director or needle of Deschamps. Put the instrument under the artery carefully on its inside, to bring it out externally, and hold the artery with the finger to prevent its slipping, placing the finger between it and the first fasciculus of the brachial plexus. This manœuvre is rendered easier by lowering the shoulder and turning the patient's head on the other side.

M. Roux has proposed an incision perpendicular to the clavicle, Marjolin a \perp incision with the base inferior,* Physick a V incision, &c. Lisfranc's proceeding is incontestibly the most simple and best. I have some facts to add to it.

Lisfranc extends his incision inwards to within one inch of the sterno-clavicular articulation, on which account he often falls on the outer border of the sterno-mastoid; and he recommends, when that happens, to divide this muscle in all the extent of the external incision. It is useful to have as large an external incision as possible in fat or muscular subjects to enable us to act freely at the depth at which the artery is met with; but in a thin subject we may well stop at the external border of the sterno-mastoid, as the scalenus anticus projects at least as far outwards, and need not be divided, the artery being tied outside it.

Students unaccustomed to this operation, often find

Fig. 3.



Ligature of the Axillary, Subclavian, Carotid, and Lingual Arteries:—*a*, line of incision for the axillary artery; *b*, line of incision for the subclavian artery—the dotted line represents the additional incision of Marjolin and Liston; *c*, line of incision for the arteria innominata; *d*, line of incision for the carotid in the place of election; *e*, line of incision for the lingual.

* Liston advises an incision along the whole course of the clavicle, joined by another along the outer border of the sterno-mastoid muscle, like the \perp incision of Marjolin, Fig. 3. *b*. Liston's Op. Surg. p. 199.

it very difficult to reach the costal tubercle in following the indication of Lisfranc. I have found it more sure to pass the finger by the external angle of the wound to the first rib, then along it from without inwards until it meets the tubercle. On some subjects it is but slightly marked; we may then help ourselves by the projection of the external edge of the scalenus anticus, which is inserted into it. Moreover, as it is essential in a like operation to know, at all events nearly, the position of the artery, I will state what I noticed in this respect on an adult and well-made subject, the clavicle being a little more than five inches in length. The artery, in its passage on the first rib, was two inches from the sterno-clavicular articulation, about three lines and a half outside the internal third of the clavicle.

In some subjects, the rib is so covered by the clavicle and the artery so buried that it is excessively difficult to isolate it. We then have a resource in the following method:—

II. BETWEEN THE SCALENI. *Proceeding of Dupuytren.*—The operation is commenced as in the above-described proceeding, only the division of the external fasciculus of the sterno-mastoid is required. The costal tubercle recognized, a director is passed behind the scalenus anticus, and on it, its inferior attachment divided. In consequence of this division the muscle retracts upwards, and the artery is seen taking an oblique direction upwards and outwards, which, even without its pulsation, distinguishes it from the nerves of the brachial plexus, whose course is oblique in the opposite direction. The director is passed under the artery from without inwards.

Everybody has pointed out the danger of wounding in this operation the phrenic nerve, which descends on the internal side of the scalenus anticus, and a little anterior to it; but I have not seen the presence of the internal mammary artery mentioned anywhere. It is placed immediately outside this nerve, and consequently is still more exposed, if you cut too near the rib. It is essential, in order to avoid these two organs, to begin some way from the rib, and to divide the muscle by degrees from without inwards, so that we may recognize after each cut the parts the knife will divide in the next.

III. INSIDE THE SCALENI.—On the right side this portion of the artery—extremely short on account of the arteria innominata, furnishing six branches, covered by the internal jugular and vertebral veins, crossed by the trisplanchnic, pneumogastric, and phrenic nerves—would offer almost insurmountable obstacles to the operation.

On the left the artery is longer, springing from the aorta itself, but situated more deeply, covered by the lung, the subclavian vein, the phrenic and pneumogastric nerves; in contact internally with the carotid, externally with the pleura, behind with the thoracic duct. The operation would be fearful, though offering more chance than on the right, in consequence of the greater length of the vessel, which would permit a coagulum to form. If you wish to attempt it, you may adopt the proceedings to be described for the brachio-cephalic. It was once performed by Colles. The patient died the ninth day.

(6.) *Ligature of the Brachio-Cephalic.*

Springing from the transverse portion of the aorta, its course is described by a line descending from the right sterno-clavicular articulation towards the mesial line, an inch below the upper edge of the sternum. We may feel its pulsation in the fossa over the sternum: by turning back the head we cause it to rise a little in front of the neck.

Proceeding of King.—The patient is laid on his back, his head thrown backwards, and his face turned to the right. The surgeon on his left feels with his finger for the internal edge of the right sterno-mastoid, incises the skin parallelly to this edge, slightly inside it, and at its inferior part, to the extent of two inches; separates with the fingers or director the cellular sheath that separates the sterno-mastoid from the sterno-hyoid and sterno-thyroid, then that which separates these two muscles from the trachea. Having reached the cellular tissue, in which the sub-thyroid veins pass, he puts them aside, or divides them, after having tied them; strips and puts aside the left subclavian and the right internal jugular veins; then making the patient bend forward his head, he passes in the index-finger till it reaches the artery between the trachea and sterno-hyoid; recognizes it, and with a director, blunt and bent, first isolates it on the right, then on the left and behind. The artery at last isolated in its whole circumference, and the director passed under it, it remains only to place the ligature, with a probe, or rather with a needle fixed in a handle. Especial care must be taken not to wound the two veins, pneumogastric nerve, or pleura.

This method, though easy on the dead body, would be extremely difficult on the living, on account of the contraction of the muscles; and Mr. Key, who tried it, in order to tie the carotid near the sternum, could only attain his object by cutting across a portion of the sterno-mastoid.

Proceeding of Mott.—The patient is placed in the same position, but his face a little inclined to the left shoulder. The surgeon, standing on the right side, makes a horizontal incision from the median line of the neck, directed outwards for two and a half inches, at about half an inch above the clavicle. Another incision of the same length follows the internal border of the right sterno-mastoid, and falls on the extremity of the first. In the same direction the sternal end of this muscle is cut, and most of its clavicular portion also, which is turned upwards and outwards. The sterno-hyoid and thyroideus are cut on a director carefully passed under them. It only remains to separate with the director or fingers the cellular tissue and veins that conceal the artery, to isolate, and tie it.

Manec rejects the longitudinal incision of the skin; but Graefe, who, after Mott, tied the artery on the living subject, thought fit to follow the same method. Of the two patients, one died on the twenty-sixth, the other on the fiftieth day.

I am not an admirer of this operation; and if it should ever succeed,

I think it will only be by the adjunction of “*mâchures*”* to the ligature. Be that as it may, I think the method of King absolutely to be rejected: even that which I have proposed for ligature of the carotid near the sternum, though more easy, perhaps would not give freedom enough to the operator; and muscular incisions are of little consequence weighed against the serious danger of the operation. I should give the preference to the method of Mott.†

(7.) *Ligature of the Common Carotid.*

Surgical Anatomy.—The common carotid arises, on the right side, from the brachio-cephalic on a level with the superior border of the sternum, on the left from the transverse portion of the arch of the aorta, that is to say, one inch or one inch and a quarter below this level. They each ascend along the vertebral column, on the outside of the trachea and larynx, which are here the best guides, and bifurcate at a variable height, but generally, in the male on a level with the superior edge, in the female opposite the middle, of the thyroid cartilage. They are nearer together below, where the right partly rests on the trachea, more separated above on account of the greater breadth of the larynx. In this course each is enclosed in a sheath, together with the internal jugular vein, which runs along its external side, and partly covers it, and the pneumogastric nerve between the two vessels and behind; they do not give off any branch before their bifurcation, and may be tied in any part of their course above the sternum.

The old method, which I shall first describe, applies specially to their middle and upper portion.

Ordinary Proceeding.—The artery after being crossed by the sterno-mastoid lies on its inside, and its pulsations may be felt.

Lay the patient on his back, his chest slightly elevated, his neck extended, and his head, inclined to the healthy side, fixed by assistants, and make an incision of about two inches and a half, along the internal edge of the sterno-mastoid; divide successively the skin, the subcutaneous cellular tissue, the platysma (taking care not to wound the anterior jugular vein, which is sometimes large), then the portion of the cervical fascia that unites the sterno-mastoid to the sterno-hyoid and thyroid. Flex the head of the patient and separate these muscles with blunt crotchets, then the omo-hyoid shows itself running across; put it aside or divide it if necessary; and the deep layer of the cervical fascia, forming the sheath of the vessels, and enveloping in its layers the loop of the hypoglossal nerve and the omo-hyoid muscle, alone remains to be divided. The internal jugular is thus exposed, swollen with blood, especially during expiration; put it aside cautiously and gently; if it entirely conceals the artery, compress it with the finger of an assistant at the upper angle of the wound, tear aside with the director the cellular tissue that unites the vessels, then the

* See XVI., page 58.

† This operation has been performed five times, but never successfully. By Mott in 1813; by Graefe in 1822; by Norman of Bath in 1824; Lizars in 1836; and M. Hutin in 1842.—F. B.

proper sheath of the artery; and, lastly, pass the director beneath it from without inwards, taking care not to include with the artery the pneumogastric nerve, which should be left on the outside with the vein.

In exactly following this proceeding we are obliged, on the one hand, to drag the sterno-mastoid, outwards, which uncovers a portion of the jugular vein and tracheal muscles, and on the other to push inwards those muscles that cover the artery, besides the almost indispensable division of the omo-hyoid. The result is, that when all these parts put aside return to their places, the ligature is at the bottom of a zigzag wound, having at least three different directions, from within outwards under the sterno-mastoid, from without inwards under the tracheal muscles, and from before backwards on each side of the artery, so that the pus with difficulty escapes and most embarrassing sinuses form.

This inconvenience would be obviated by cutting across a part of the tracheal muscles; the dread of by so doing considerably hindering the functions of these muscles for the future is not really well founded.

But this method is very vaguely described. I have more than once seen the operator, trying to cut on the internal border of the sterno-mastoid, fall on the sterno-hyoid, and in doubt as to what was the muscle before him. If the ligature is to be put very low down, the proceeding is insufficient; if high up, it is badly indicated; consequently I reject it. I distinguish two situations for ligature of the carotid—a place of choice, and a place of necessity.

The place of election is immediately below the bifurcation of the vessel, that is to say, on a level with the upper border of the thyroid cartilage in the male, and opposite its middle in the female.

The place of necessity is always much lower, whether we operate for aneurism or for a tumour of the trunk itself; but the method that permits tying the artery as low as possible, always suits for tying it a little above. All is reduced then to two methods.

I. AT THE UPPER PART. *New Proceeding.*—The external incision, two or two inches and a half long, should be so disposed that its middle fall on a level with the bifurcation of the artery (variable in the two sexes, as we have said). In this point the artery, disengaged from the tracheal muscles, is exactly on the internal side of the sterno-mastoid, one essential guide; if necessary, we have a second in the larynx, on the inner side of the vessel.

The patient being placed as for the preceding operation, the surgeon makes an incision along the internal edge of the sterno-mastoid, or rather some lines outside, for fear of missing the muscle. If it does not make a very apparent projection, follow the direction of a line drawn from the internal extremity of the clavicle to the mastoid process.

The first incision should divide the skin and platysma, so as to expose the sheath of the muscle; the second exposes the muscle near its external border; beneath this border is the posterior layer of the muscular sheath, which also forms the sheath of the vessels. Divide

it cautiously, and you fall on the two vessels—the artery inside, the vein outside. Isolate them as usual.

This method, in addition to its greater facility, has the following advantages. We are less exposed to meet the anterior jugular vein, and we avoid the loop of the hypoglossal nerve, which passes on the carotid about one inch below its bifurcation. And lastly, we have a more superficial wound, without sinuosities.

II. AT ITS INFERIOR PORTION.—The artery is covered first by the sterno-thyroid and sterno-hyoid, more superficially by the internal fasciculus of the sterno-mastoid, and by the subcutaneous layers.

Proceeding of M. Sedillot.—He declares, in opposition to what has been said, that the artery passes from its origin, under the cellular interstice separating the two portions of the sterno-mastoid. He makes an incision two inches and a half long, which passes from the internal end of the clavicle, obliquely upwards and outwards in the direction of this interstice. The skin, platysma, and deep fascia are successively divided, the two portions of the muscle drawn apart with the edges of the wound, and the external jugular vein is reached inside the anterior scalenus and phrenic nerve. The common vascular sheath is opened, the vein turned to the outside, and the artery sought at its internal side. But there would be so much danger in thus attacking the internal jugular vein in the living subject, at the bottom of a wound narrowed by the contraction of the two fasciculi of the muscle, that I would not advise any surgeon to try this proceeding.

Proceeding of Key.—He tried to lay bare the artery by a simple incision parallel to the internal edge of the sterno-mastoid. I have already said he was obliged to divide it partly across.

New Proceeding.—According to what has been said, the sterno-mastoid is no longer the satellite muscle to the artery in this situation, but the sterno-thyroid, which is a little overlapped outside by the sterno-hyoid. The trachea is always the last guiding mark. The sterno-hyoid should then be first largely bared on its outside, raised, and partly cut across, if necessary, and the sterno-thyroid exposed. The artery is to be sought for under its external edge.

The patient should lie down with his head thrown back, but without any rotation to the right or left. I make an incision two inches long, commencing from one-third of an inch above the sterno-clavicular articulation, and in the direction of a line passing up from this articulation, and rising towards the symphysis of the chin. The first cut should expose the cervical fascia; the second divide it and expose the fibres of the sternal portion of the sterno-mastoideus; the third divides this fasciculus in the direction of the external wound; then the two tracheal muscles appear enveloped in a common cellular sheath, and separated only by a lamellated tissue, without any consistence. The anterior layer of this sheath is divided, which exposes the sterno-hyoid. If it extends far outwards, cut across its external portion; if not, raise it inwards with the sterno-thyroid. The posterior layer of their sheath is confounded with the sheath of the vessels. It is opened as near as possible to the trachea, on the outer

side of which we find the artery, which is isolated in the way we have said. If in the living subject, the engorgement of the parts, the infiltration of blood in the cellular tissue, or any other cause, leaves any doubt as to the situation of the artery, we have a last guide in the carotid tubercle, pointed out by M. Chassaignac. This tubercle is formed by the projection of the anterior branch of the transverse process of the sixth cervical vertebra, which is much more distinct than the others, and is found two inches above the clavicle, under the internal edge of the sterno-mastoid. It is easily felt after the incision of the first layers. It corresponds in front, and a little inside, to the carotid artery. This indication is so precise that, in the subject, by holding a finger on the tubercle, we may plunge the bistoury directly into the artery without any previous incision of the integuments. It is only essential that the neck be retained absolutely straight, the least rotation sufficing to modify the relations.

(8.) *Ligature of the Lingual Artery.*

Béclard proposed to tie it above the os hyoides. The method described up to the present time was founded on the fact that the artery, arrived on a level with the extremity of the great cornu of the os-hyoides, passes between the middle constrictor of the pharynx and the hyoglossus, and runs so that it is one line above the greater cornu behind, and three-fourths of an inch from the body of the bone in front.

Old Proceeding.—The patient was laid on his back with his neck extended, and face inclined to the sound side. An incision, about one inch long, was made in the direction of the artery, indicated by that of the os-hyoides. The skin and platysma divided, the fascial vein was pushed outwards, and the cellular sheath of the sub-maxillary gland opened. This gland was raised without being cut, as also the digastric and stylo-hyoid. The hyoglossus thus laid bare was carefully divided, its fibres being raised with a dissecting forceps or on a director, and beneath it the artery was found, then very easily isolated.

This ligature, thus described, is one of the most hazardous operations that can be tried, even on the dead subject. M. Mirault performed it on a woman affected with cancer of the tongue; and he prefers an incision starting from the middle of the grand cornu, reaching to the anterior edge of the sterno-mastoid, passing half an inch below the angle of the jaw, and thus crossing the direction of the artery. He succeeded on the right side, but missing his guiding points, he was obliged to give up his search for the artery on the left side. I have no hesitation in saying that the plan I am going to describe makes this ligature one of the easiest the surgeon can attempt.

New Proceeding.—The lingual artery, as we have said, runs parallel to the great cornu of the os hyoides. It suddenly changes its direction in a precise spot, easily recognized when the skin is incised, viz., opposite a small osseous projection, neglected, or not noticed by authors, which occupies the upper border of the great cornu of the os

hyoides, one or two lines from the lesser cornu. The greater cornu first recognized, an incision about an inch long, comprising the skin and platysma, must be made two lines above, and parallel to it.* We thus fall on the inferior border of the submaxillary gland, our first guiding point. This gland being a little pushed up, we find beneath it the tendon of the digastric, remarkable for its pearly brilliancy: second guiding point. Half a line above, is a whitish cord, sometimes concealed by some fibres of the stylo-hyoid. Free it, if necessary, with the point of the bistoury: it is the hypoglossal nerve. This third point well recognized, at one line below it divide transversely the hyoglossus muscle, and you fall directly on the artery, which is not accompanied by any vein or nerve. The facial vein is more superficial, and crosses the incision obliquely from without inwards, and from below upwards. The skin, on this account, and the platysma must be cautiously cut; and the vein, which is tolerably large, being seen, must be pushed outwards.

I should mention that in some women the os hyoides rises so high under the jaw that the submaxillary gland covers its great cornu, and even overlaps it by several lines. Then the lingual artery is at so great a depth that the operation requires an enormous external incision even on the dead subject; and on the living it would probably be impossible to put it into execution. Methods have also been proposed for most of the arteries of the neck and head, vertebral, thyroid, internal and external carotid, facial, coronary arteries of the lips, sub-orbital, temporal, and occipital. These methods not seeming to me to be applicable on the living subject, I have not thought fit to describe them.

INFERIOR AORTIC SYSTEM.

(1.) *Ligature of the Anterior Tibial Artery in the Foot (Arter. Dorsalis pedis).*

If a straight line be drawn from the middle of the inter-malleolar space to the posterior part of the first inter-osseous space, we have the direction and extent of the artery, situated between the tendon of extensor pollicis proprius on the inside, and the first fasciculus of the extensor communis on the outside. This fasciculus is the essential guide, and should be especially sought for.† An incision one inch and a half long is made in the indicated direction, terminating at the first inter-osseous space.

The skin, cellular tissue, and fascia are successively divided, and we then recognize the first fasciculus of the extensor communis. This found, divide the deep layer of the sheath of this muscle along its internal border, and you come on the artery with its two collateral veins, and on the outside of it a branch of the posterior tibial nerve. Pass the director from within outwards. Others direct the incision

* Fig. 3, e. p. 149.

† These indications may be easily found by making the patient forcibly extend his toes.—F. B.

towards the second metacarpal bone. It then slightly crosses the artery.

I have seen the dorsal artery in two subjects terminate on the external part of the tarsus. The anomaly only existed on one side.

(2.) *Ligature of the Anterior Tibial Artery.*

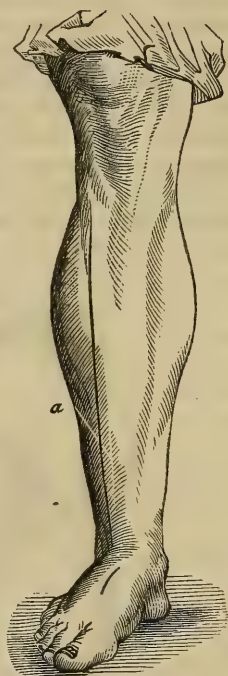
Extending in the direction of a line drawn from the middle of the space between the head of the fibula and the spine of the tibia, to the middle of the inter-malleolar space, the artery lies on the inter-osseous ligament in its two upper thirds, then on the anterior external surface of the tibia, being more deeply situated the higher you examine it. It is not tied at all in its lower fourth, on account of its proximity to the articulation, nor in its upper fourth, on account of its too great depth. The proceedings are the same for all the intermediate space.

Ordinary Proceeding.—The patient is laid on his back, with his leg extended; the foot is moved, to cause the tendon of the tibialis anticus to become prominent, and the projection of this tendon and its muscle is then followed with the end of the finger to the place where we wish to incise. To this indication, the line marking the course of the artery is moreover joined.

An incision two inches and a half long is made in this direction. The skin being divided, the fascia is first cut longways, then each of its edges across. Then seek with the fingers and eye the first tendon outside the tibia, or if the incision is made very high up, the first inter-muscular space. For its better discovery, the finger is applied on the tibialis anticus laid bare; and on pressing from within outwards, we are resisted by the other muscles. Separate the muscles with the index-finger, then flexing the foot, and holding apart the muscles by means of blunt hooks, the artery is seen, with its two veins and the tibial nerve. The latter is outside all the vessels superiorly, crosses them in the middle, and lies on the inside inferiorly. To isolate the artery, which is often difficult, the director must be strongly bent, and carried very obliquely under the vessel from below upwards, from the fibula towards the tibia. We may use the needle of Deschamps in the same way.

When the rules for the incision are neglected, it often happens that the operator falls on the second interstice, between the extensor proprius pollicis and the extensor communis, and cannot find the artery. The surface of the muscles, starting from the tibia, must then be explored to find the interstice required.

Fig 4.



Ligature of Anterior Tibial Artery: — a, Lisfranc's incision.

Proceeding of M. Lisfranc.—To avoid all chance of error, Lisfranc proposes that the incision, commenced on the external side of the crest of the tibia, mount obliquely outwards, so as to be *about* one inch distant from this crest superiorly, *according* to the muscular development. Then before dividing the fascia lengthways, he makes an incision across it, through which he recognizes the interstice of the tibialis anticus with certainty. This proceeding is safer than the other; but the external incision, if too oblique, might hinder any farther researches. Perhaps it would be better to combine them together.

(3.) *Ligature of the Posterior Tibial Artery.*

This artery is almost in the direction of a line, passing from the middle of the ham to between the tendo Achillis and the internal malleolus. It may be tied at three points.

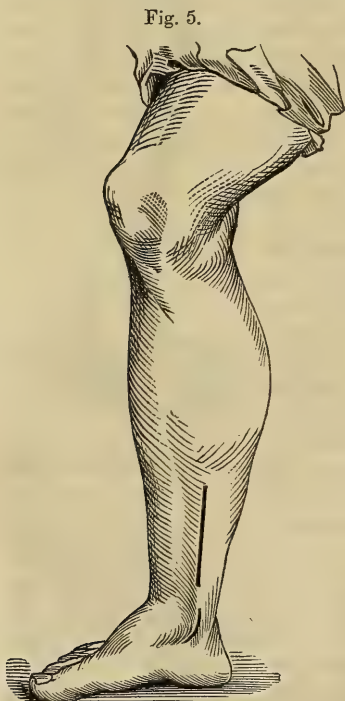
I. **BEHIND THE INTERNAL MALLEOLUS.**—It is situated atmost parallel to the posterior border of the malleolus, behind the sheath of the tendons of the flexor profundus and tibialis posticus, covered only by the skin and fascia.

Proceeding of Lisfranc.—A longitudinal incision is made two lines behind the external malleolus, extending half an inch below, and one inch and a quarter above it. The skin being incised, the fascia is divided on the director, and we have the artery before us, with its satellite veins. The nerve is behind and outside, consequently the director is passed under the artery from either side indifferently.

Velpeau would have the incision made at least half an inch from the malleolus. Manec makes it exactly in the middle, between the tendo Achillis and malleolus. The position of the artery varying in different subjects, this last incision permits better than the others to lay it bare in all its varieties.

II. **IN THE MIDDLE THIRD OF THE LEG.**—The artery passes parallel to the internal border of the tibia, three-fourths of an inch from it. It is covered by the deep fascia, the superficial fascia, and skin.

Ordinary Proceeding.—An incision two inches long is made, three-fourths of an inch outside the internal edge of the tibia (Manec), or at an equal distance from the bone and tendon



Ligature of the Posterior Tibial Artery.

(Velpeau). After the skin the superficial fascia is divided, then the

deep fascia is cut through on the director, and we reach the artery with its two veins, and the nerve on its outside.

If the soleus descends to the level of the incision, it must be pushed upwards and outwards with the finger, or divided if necessary. When the external incision is too near the tibia, we have only one layer of fascia to divide, but we risk not finding the artery.

Proceeding of Lisfranc.—In whatsoever point you wish to tie the artery in the extent occupied by the tendo Achillis, make an incision two inches and a half long, which rises obliquely from the internal border of this tendon to the internal border of the tibia, at an angle of 35° . Divide the skin and aponeurosis, then carry the finger into the wound with its palmar surface towards the tendon, and pass it from below upwards, to separate the soleus if necessary. The rest of the operation as usual. This proceeding is more precise and certain than the first.

III. IN THE UPPER THIRD OF THE LEG.—More distant from the internal border of the tibia the higher we go, the artery is found covered by the deep fascia, the soleus, the internal head of the gastrocnemius, superficial fascia, and skin.

Ordinary Proceeding.—The leg is flexed on the thigh, and laid on its outer side. Make a longitudinal incision three and a half inches long, two-thirds of an inch from the internal edge of the tibia, and divide the fascia crucially. Carry the finger into the wound, and push outwards the internal head of the gastrocnemius. Divide the attachments of the soleus thus exposed from the tibia, grazing the posterior surface of the bone. An assistant keeps this muscle held backwards and outwards with a blunt crotchet. Divide the deep fascia on a director, and then look for the vessel. This proceeding, very difficult on the subject, is still more so on the patient.

M. Bouchet, of Lyons, was obliged to cut across a part of the soleus to reach the vessel.*

Proceeding of Manec.—He thinks the ligature should generally only be attempted below the upper fourth of the leg.

The external incision made as we have said, and the soleus laid bare, this muscle is divided in its whole thickness at, at least one inch from the internal edge of the tibia. Proceed gently, gradually putting aside the edges of the wound, to recognize the anterior aponeurosis of the muscle, a thick pearly layer, on which the fleshy fibres are inserted. Slip the director under it, and incise it as largely as the external wound; then the deep fascia covering the vessel is exposed. Divide it also on the director, and isolate the artery as usual or with the needle of Deschamps.

(4.) *Ligature of the Peroneal Artery.*

Too deeply placed in the upper part of the leg and not of sufficient importance in the lower, we can only think of tying it in the spot

* Mr. Guthrie considers the operation to be so "dangerous, painful, tedious, difficult, and bloody," that he proposes to reach the artery by making a perpendicular incision of six or seven inches in length at the back of the leg through the skin, gastrocnemius, plantaris, and soleus. See Druiitt, p. 546.

where the soleus separates from the gastrocnemius, a little below the middle of the leg. There it runs along the posterior surface of the fibula, sometimes between the fibres of the flexor pollicis or between it and the tibialis posticus.

Proceeding of Lisfranc.—An incision is made two inches long from the external border of the tendo Achillis obliquely upwards, and outwards to the external surface of the fibula. Hold aside the external saphena vein, which presents itself under the skin. Divide the fascia; with the index finger push inwards the tendo Achillis, and destroy the cellular tissue covering the deep fascia. The latter being divided on the director, seek the first muscular interstice of the deep layer, starting from the fibula; separate and raise on the finger the flexor of the great toe, and you find the artery in the situation mentioned above. This proceeding is far from being sure, and we succeed better by the following

New Proceeding.—First seek the external edge of the fibula, the essential point of guidance, and one or two lines behind it; make an incision two or three inches long, parallel to the bone. On most subjects after the incision of the skin and fascia the edge of the bone is easily recognized by the finger and eye, in some it is concealed by the external edge of the soleus; in any case this muscle must be slightly separated and pushed inwards with the finger. Then only we plainly perceive the edge of the bone which serves as a starting point. On the outside, it is in relation with the peroneus longus; inside and behind, with the flexor pollicis proprius which is attached to the posterior surface of the bone. Instead of pushing this muscle outwards, as in the method of Lisfranc, separate it from its attachments to the fibula to draw it inwards, and you find the artery at its internal side.

We should always be well aware that this muscle presents on its anterior or deep aspect a thick aponeurosis, which must be divided before we reach the vessel. I have seen operators much embarrassed because they were content with dividing the fleshy fibres and sought the artery on the aponeurosis whilst it lies immediately under it.

(5.) *Ligature of the Popliteal Artery.*

Extending from the lower fourth of the thigh to the upper fifth of the leg it traverses the popliteal space, first a little obliquely from above downwards and from within outwards, then almost perpendicularly in the median line but a little to the inside. Above, it has the vein and nerve to its outer side; a little lower they cross it, passing over its posterior surface, so that inferiorly the vein is inside. It may be tied in two places.

I. IN ITS INFERIOR PORTION. *Proceeding of Lisfranc.*—Lay the patient on his belly with his leg extended. Feel with the finger the interval that separates the two heads of the gastrocnemius, and make from above downwards a longitudinal incision three inches long, commencing one-third of an inch below the articulation of the knee, slightly on the outside of the median line, because the internal head of the gastrocnemius is larger than the external.

Put aside the external saphena vein, which often presents itself under the skin. Divide the fascia to the same extent, and then find with the index finger the interval between the two heads of the gastrocnemius which are separated without using the bistoury, moderately flexing the leg on the thigh. At the bottom of this interval lies the nervo-vascular bundle. The nerve first shows itself beneath, and on the inside of it is the vein and on the outside the artery. (These relations are not always exactly the same.) Draw the nerve and vein inwards and pass the director under the artery from within outwards.

By prolonging farther down the separation of the heads of the gastrocnemius, and dividing the aponeurotic arch of the soleus, we should reach the division of the artery, and might tie near their origin the anterior tibial, peroneal, or posterior tibial.

Proceeding of Marchal.—In the execution of this proceeding we must bear in mind that the inferior triangle of the popliteal space is bounded on each side by the heads of the gastrocnemius, which alone cover the artery before it passes under the arch of the soleus. Instead of separating these heads to find the artery beneath and between them, the incision is made on the inside of the internal head, underneath which we seek the vessel.

Place the subject on his back with the thigh abducted, the leg moderately flexed and resting on its external surface; the surgeon, standing on the outside of the limb, feels for the internal side of the muscular mass that bounds the superior popliteal triangle internally and below, begins his incision at this point, and continues it from above downwards, from without inwards, and from behind forwards, to the extent of two inches and a half, and to within half an inch of the internal border of the tibia, passing along the edge of the internal head of the gastrocnemius.

Take care in finishing the incision not to completely divide the skin, to avoid the saphena vein, which generally passes immediately behind the internal tuberosity of the tibia, but sometimes more to the posterior part of the leg. The aponeurosis laid bare should be divided in the same way, but a little further back than the skin, so as to avoid the tendinous insertions of the goose's foot ("patte d'oie"*). Incise it parallelly to the posterior

Fig. 6.



Popliteal Space ;—*a*, artery ; *b*, vein ; *c*, nerve.

* A name given to the expansion of the tendons of the Sartorius, Gracilis, and Semi-tendinosus.

edge of the tendon of the sartorius, then lay down the knife and introduce the index finger of the right hand under the internal edge of the gastrocnemius, between this muscle and the popliteus: by flexing the leg on the thigh we relax the muscles. Destroy the loose cellular tissue that is found in the intermuscular space, and we reach the vasculo-nervous bundle, which is perfectly visible at the bottom of this space, the nerve to the inside, then the vein, and lastly the artery; but by the movement of flexion the nerve passes outwards and leaves the vessels bare and accessible. Separate the vein from the artery with the director, and carry it outwards. Pass the director under the artery from without inwards, and from below upwards, as parallelly as possible to the axis of the vessel, which is brought to the surface of the wound and tied.*

II. AT ITS UPPER PART.—Make an incision three or four inches long, starting from the inferior third of the thigh on a level with the commencement of the artery, and near the external border of the muscles which bound the popliteal space on the inside to the middle of the popliteal space itself, on a level with the articulation. After the skin and fascia, we come to a mass of adipose tissue, which tear with the fingers and director. At the bottom of this mass we find first the nerve, most superficial, and a little outside the vessels; next the vein; and inside at a greater depth, the artery sometimes covered by the vein, and isolated with difficulty. The artery being very deep, if the incision thus made does not fall exactly on it, the operation is very difficult to finish. Lisfranc advises directing the incision almost vertically from the base of the popliteal triangle marked by the projection of the muscles, to the summit of the same triangle. This incision slightly crosses the course of the vessel and prevents our going astray. M. Jobert proposes seeking the artery by means of an incision through the depression seen just above the internal condyle of the femur, the leg being semiflexed, and penetrating between the vastus internus and the muscles that form the internal border of the popliteal space. But all these methods are only used on the subject; we prefer tying the femoral instead of the popliteal.

(6.) *Ligature of the Femoral.*

Extending from the crural arch to the lower third of the thigh, it follows the direction of a line drawn from the middle of this arch to the middle of the popliteal region passing round the thigh obliquely

* In England the aneurism needle is preferred. Mr. Liston, in describing the manner in which the ligature is to be applied, remarks—"This must all be done without disturbing the vessel, without detaching it from its sheath or breaking up its fine cellular connections laterally and behind, farther than is barely sufficient for the passage of the needle. There must be no elevation of the vessel on the handle of the knife or on the director, as if in triumph at the almost unexpected success in finding it. This practice seems still followed, and is even represented in the plates accompanying some modern surgical works. Those who teach or countenance proceedings of the kind, must have paid but little attention to the physiology and pathology of the circulating system, and must have had but few opportunities of witnessing surgical practice. Ulceration of the vessel, and secondary hemorrhage on or about the separation of the ligature, are the almost inevitable consequences of the practice here reprobated."—*Liston's Oper. Surg.* p. 189.

inwards. The sartorius crosses it very obliquely, so that above it is quite on its outside whilst it covers it in the middle; and inferiorly the artery is again on its outer side. This muscle, then, forms a guide always certain in the normal condition, and is that we must first seek. But the direction of the incision should vary according to the spot where the artery is to be tied.

I. AT ITS INFERIOR PART.—The thigh being slightly flexed on the pelvis, the leg on the thigh, and the limb resting on its external surface, we seek the outer edge of the sartorius, or, if we cannot find it, make in the direction of the artery an incision three inches long, half on the middle, half on the lower third of the thigh. The skin divided to the fascia, make sure of the situation of the sartorius with the finger. Incise the fascia some lines inside its external border and dissect into its sheath with the finger. An assistant then holds it inwards. Raise the posterior part of this sheath with the director and cautiously divide it. We then fall between the triceps and adductor-magnus, on the canal formed by the latter for the artery, which we recognize by its pulsation. Divide the canal on the director, and we find the artery with the crural vein on its inside, the saphena nerve on its outside. Pass the director from without inwards. This manœuvre is very delicate, the vessels being united at this point by a compact cellular tissue.

II. AT ITS MIDDLE PORTION.

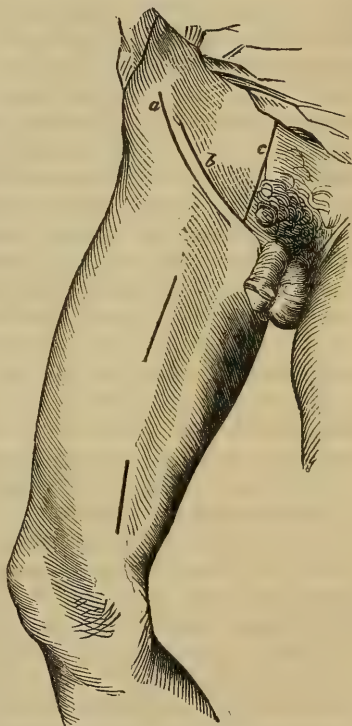
Proceeding of Hunter, modified by

Lisfranc.—An incision two and a half inches long should be made in the middle third of the thigh, in the middle of the space between

the vastus internus and sartorius. At its lower end it should be two lines from the internal border of the last named muscle, and superiorly four or six lines. The skin and fascia being divided, we fall on the internal border of the sartorius, which should be elevated outwards. The posterior layer of its sheath should be divided on the director, and we find the artery more easy to isolate, as it has not yet entered the fibrous canal of the adductor magnus.

If the sartorius running too much inwards causes the discovery of the artery to be difficult, the incision should be enlarged in its upper part (S. Cooper). In this proceeding, we risk wounding the internal

Fig. 7.



Ligature of Femoral and Iliac Arteries;—*a*, incision of Sir A. Cooper; *b*, incision of Bogros; *c*, incision of Abernethy for the external iliac, and Stevens for the internal.

saphena vein. Roux advises incising along the external edge of the sartorius and pushing it inwards; not a very sure plan at this height. Desault, to avoid all error, made his incision on the middle of the sartorius, and even proposed cutting it across. When the interstices of the muscles can be felt, the plan of Lisfranc is certainly the surest; if not, it is prudent to make the external incision after the plan of Desault, then to raise the sartorius outwards without cutting it.

III. IN THE UPPER THIRD OF THE THIGH. *Proceeding of Scarpa.*—The artery is found here almost bare, in a triangle whose base is the crural arch, and whose summit is formed by the meeting of the sartorius and adductor longus.

The most favourable point for tying it is about four to five inches below the crural arch (Hodgson). The profunda arising one inch and a half at most below this arch, there is space enough for the coagulum to form in. Explore its direction with the finger, and carefully mark the spot where its pulsation ceases to be evident—that is to say, where the sartorius passes over the artery. Begin an incision three inches from this point along the internal border of the sartorius. Great care must be taken to avoid the saphena vein, which lies almost in the same direction;* then pass a director under the fascia, and divide it; the artery then presents itself, with the vein on its inside and behind, the nerve on its outside; tear, or lightly incise its sheath; and as the nerve is here of slight importance in comparison with the vein, pass the director from within outwards.

Hodgson incises the fascia to the extent of about an inch only. Scarpa makes the incision as large as that in the skin, with the intention of avoiding strangulation and the formation of abscesses under the fascia. Samuel Cooper very correctly observes that it is the application of the bandage that determines these accidents. It is sufficient to open the aponeurosis, so as to permit the isolation of the artery. Lisfranc commences the incision half an inch below the middle of the arch, and continues it about three inches in the direction of the artery itself. But we could not thus tie the artery in the place of election pointed out by Hodgson.

IV. UNDER THE CRURAL ARCH.—The artery corresponds, as we have said, to the middle of the space that separates the spine of the pubis from the anterior superior spinous process of the ilium. But in women, whose pelves are more expanded, the artery is a little nearer to the pubis. It may be easily felt with the finger. It is there placed with the vein in an aponeurotic canal, formed by the separation of the two layers of the fascia lata (crural canal). The nerves, situated more externally, are not comprised in the canal.

As it is very superficial, excepting the indications required for the external incision, we need not on the living subject seek any other guide than its pulsation.

Make then, in its direction, an incision from one and a half to two

* Dr. Jones Quain remarks, "This accident (wounding the saphena vein) may happen to any individual who, from supposing that the artery inclined inwards as it descends, makes his first incision oblique so as to correspond with such a direction of the vessel."
—(Anat. page 580.)

inches long, starting from the crural arch. The skin and cellular tissue divided, pass the director under the fascia, divide it, and you reach the vessels. The vein, which is the largest, presents itself first. Push it inwards, and pass the director from within outwards, under the artery placed at its external side, and as much as possible immediately above the origin of the superior profunda.

(7.) *Ligature of the External Iliac.*

It extends from the sacro iliac symphysis to the middle of the crural arch in a straight line, along the projection formed by the psoas, having the iliac vein on its internal side and posterior, a small nerve between them, or even altogether on the artery, and another small one entirely outside of it. A loose cellular tissue unites the vessels to each other, and to the peritoneum, which covers them.

There are three principal proceedings, known under the names of Abernethy's, Astley Cooper's, and Bogros's.

Proceeding of Abernethy.—Let the patient be laid on his back, a little inclined to the healthy side, to cause the intestinal mass to incline there and with the abdominal muscles completely relaxed. Commence above the ligament of Fallopius (Poupart's ligament), half an inch outside the inguinal ring, an incision which mounts obliquely on the abdomen for three inches in the direction of the artery. Incise in this manner the skin, then the aponeurosis of the external oblique, then carry the left index finger into the inferior angle of the incision under the edge of the internal oblique and transversalis, and divide them on the finger to the extent of one and a half inch with a concave bistoury; then raise and push upwards and inwards the peritoneum on the psoas muscle so as to lay bare the artery one and a half or two inches above Poupart's ligament. It may be recognized by its pulsation, and isolated with the director or needle of Deschamps from within outwards.

In a first attempt, Abernethy made the incision in the course of the artery itself. The fear of wounding the epigastric made him prefer the plan we have described.

Proceeding of Astley Cooper.—Make an incision slightly curved, with the convexity downwards, in the direction of the fibres of the external oblique, commencing a little above the iliac spine and terminating a little above the internal edge of the inguinal ring, and some lines inside the middle of the crural arch. Divide in this way the skin and aponeurosis of the external oblique, and the flap that results being raised, you perceive the spermatic cord passing under the edge of the obliquus internus and transversalis, through the internal opening of the inguinal canal. This orifice is nearly in the middle of the crural arch; the epigastric artery runs along its internal border; the external iliac is immediately below. Cut this opening outwards on the director, and the finger introduced through the wound easily feels the artery, which now only requires isolating.

Roux commences the incision half an inch above the spine of the ilium, and terminates it on a level with the middle portion of the crural arch.

Proceeding of Bogros.—Immediately above the crural arch make an incision two or three inches long, whose external extremity is as far from the spine of the ilium as the internal is from the symphysis pubis. The skin and *fascia superficialis* being divided, and the edges of the wound put aside by a careful dissection, we lay bare in the whole extent of the wound, the aponeurosis of the external oblique. Make a small opening in this aponeurosis at the internal angle of the wound, introduce a director through it and divide it parallelly to Poupart's ligament. The edges of this second section being turned aside, raise the spermatic cord under the upper lip of the wound, and destroy the slight adhesions of the cremaster muscle to the crural arch with the end of the director; then the fascia transversalis appears, pierced in the middle by an opening through which the cord enters the inguinal canal. Dilate this opening with the finger and director, and we expose the epigastric artery, placed immediately behind the aponeurotic layer; follow this artery with the finger to its origin, turn aside the cellular layers and lymphatic ganglions that conceals the iliac artery, and expose the vessel.

Appreciation.—According to my experience on the dead subject, the proceeding of Bogros is preferable when the iliac artery needs tying in its lower portion. It exposes us always to the danger of cutting the external epigastric artery, which may need a ligature. The jet of blood would come from the lower lip of the wound, or from one of its angles.

In order to reach two inches higher up above the crural arch, Bogros advised carrying a button-pointed bistoury into the external angle of the wound, and enlarging the incision upwards and outwards so as to render it semilunar; but that is not enough in all cases. By the proceeding of Astley Cooper also, we cannot reach the artery high up, and it exposes us to the danger of wounding small branches of the circumflex ilii. In case, then, it is required to reach as far up as the origin of the artery, and even to the common iliac, I should prefer the proceeding of Abernethy, modified always by the following data:—

It is not quite correct to say that the iliac artery passes in the middle of the space between the symphysis pubis and the spine of the ilium. According to the measurements of Sir A. Cooper, it is found three lines more to the outside in man, and four and a half in woman. The internal border of the abdominal ring, which is bounded by the epigastric artery, is more internal than the axis of the artery by one line and a half in the male and four and a half in the female. It may be seen, then, that by cutting on the course of the artery itself we risk nothing. For greater precaution I reject the incision at three lines and a half outside, and I pursue the direction of a line which would mount to one inch outside the umbilicus. By giving it three or four inches in extent, we obtain almost the same result as the proceeding of Stevens for the internal iliac, and the best, in my opinion, for the common iliac. It is feared that this incision across the aponeurotic fibres would expose the patient to hernia afterwards. I do not know whether the danger is actually greater in this proceeding than in the

others. Perhaps, even, there might be some presumptions in favour of an opposite opinion, so that I should not be prevented from adopting this as a general method.

(8.) *Ligature of the Epigastric Artery.*

Method of Bogros.—Make an incision two lines above the crural arch, two inches long, parallel to this arch, and at an equal distance from the spine of the ilium and symphysis pubis. The skin and cellular tissue divided, slip a director under the aponeurosis of the external oblique, and divide it in the same direction; then raise the spermatic cord to discover the internal abdominal ring; dilate this ring with the finger or director. The epigastric artery is immediately behind the aponeurotic layer that constitutes the internal edge of the ring.

(9.) *Ligature of the Internal Iliac.*

Proceeding of Stevens.—Stevens of Santa Cruz tied this artery in 1812, for an enormous aneurismal tumour of the buttock. An incision five inches long was made half an inch outside the epigastric artery and parallel to it. The skin and muscles being successively divided, the natural adhesions of the peritoneum to the iliacus and psoas muscles were destroyed, and it was pushed inwards as far as the bifurcation of the common iliac. The internal iliac could then be felt at the bottom of the wound, and even pressed between the finger and thumb, which caused pulsation to stop in the tumour. The artery appeared otherwise healthy and well isolated. The ligature was tied half an inch from its origin. The patient was cured three weeks afterwards.

Anderson proposed to apply to this artery A. Cooper's proceeding for the external iliac. The above seems to us more easy and as advantageous.

(10.) *Ligature of the Gluteal Artery.*

The gluteal has been tied four times, but by very different proceedings. Generally, the operator was guided by an accidental wound, which had injured the vessel. The following is the proceeding proposed by Lizars and Harrison.

The patient lying on his belly, his thigh extended, and the toes turned inwards, draw an ideal line from the posterior superior spine of the ilium to between the sciatic tuberosity and great trochanter. At the union of the upper and middle third of this line the artery emerges from the pelvis. In order not to injure the fibres of the gluteus maximus, make an incision three inches long, commencing one inch below the posterior superior spine of the ilium and one inch outside the sacrum, obliquely towards the great trochanter, passing over the point marked out as indicating the place where the artery emerges. The skin and subcutaneous tissue being divided, separate in the same direction the fibres of the gluteus maximus; divide or tear with the fingers the thick aponeurosis covering the second layer of muscles, and we fall on the artery, situated immediately below the upper bor-

der of the great sciatic notch. As the trunk is very short, take care you do not tie one of its branches instead of the artery itself.

In a fat and muscular subject, the thickness to be traversed, the contraction of the edges of the wound, and the smallness of the artery, concealed by the flow of blood, would render the operation very difficult, if even practicable. Proceedings have also been proposed for tying the ischiadic, and internal pudic arteries. But Harrison himself only gives them as instructions in recent wounds, where the jet of blood would serve as a still surer guide to the wounded vessel.

(11.) *Ligature of the Common Iliac.*

It was tied successfully by Mott of New York, in 1827, and in 1828 by Crampton, of Dublin, with less success. Mott commenced his incision half an inch above the crural arch, outside the inguinal ring, and carried it to above the spine of the ilium, giving it a semi-circular direction and an extent of six or seven inches. We may equally well use the proceedings of Stevens for the internal iliac, and that of Abernethy, modified as we have said.

(12.) *Ligature of the Abdominal Aorta.*

Proceeding of A. Cooper.—The English surgeon made an incision along the linea alba, three inches in length, the middle of it on a level with the umbilicus, directing it a little to the left circularly to avoid this cicatrix: the linea alba divided, he made a small opening in the peritoneum, only large enough to admit the index finger; then he enlarged this opening with a probe-pointed bistoury to the same extent as the external incision; then he carried the finger to the vertebral column, and pushing the intestines right and left, explored the pulsation of the aorta, tore the peritoneum with his nail on the left side of the vessel, and by careful lateral movements got his finger between the aorta and spine, and tore the peritoneum on the right side from within outwards; the finger thus placed, served as a conductor for a needle curved and blunt, having its eye near its extremity. As soon as it had passed the artery, the thread was disengaged and the needle withdrawn. Great care was required to avoid including the intestine in the ligature. The latter being sufficiently tightened, the ends were left on the abdomen on the left side of the wound; the epiploon was pushed down as much as the ligature allowed, to facilitate reunion, and the external wound was brought together by suture and sticking-plaster.

SECTION II.—WOUNDS OF ARTERIES.

We have elsewhere (Means of Preventing the Effusion of Blood, Chap. iv., page 42) already sufficiently treated of the complete section of arteries. It remains for us to examine their imperfect division as a consequence of venesection, or of wounds of the soft parts. Under this head, three cases present themselves—wounds with external hemorrhage; false primitive aneurisms; and varicose aneurisms.

(1.) *Wounds with External Hemorrhage.*

When the artery is of a small size, we may employ pressure on the wound itself with lint or compresses steeped in a styptic liquid; or on the course of the vessel between the wound and heart; or, lastly, may completely divide the artery to favour the retraction of its two ends, and the formation of a coagulum. When the artery is large and the wound narrow, we may still hope for cure by compression; but when the vessel is largely opened we must use more powerful means.

Lambert proposed to reunite the arterial wound by twisted sutures to preserve its permeability to the artery; this method, which caused obliteration, is unanimously rejected.

There remains ligature, which here requires special rules:—

1. When the wound of the integuments is in the direction of the wound in the artery, enlarge the former to expose the vessel.

2. If the course of the wound is very oblique, try with a probe what depth it is, in what direction, and at what point the artery has probably been wounded; at this point, we must lay bare the vessel without troubling about the external wound.

3. Until we reach the artery, a solid compression must be established on its course; when it is exposed, the compression is taken off to show the point wounded, and a probe introduced in the artery to raise it slightly and facilitate its ligature.

4. To avoid the return of hemorrhage from the inferior extremity, two ligatures must be applied, one above and the other below the wound, and the ligatures brought as near the wound as possible.

5. When the wounded artery is very deep, when there is any doubt as to the vessel, as in the upper part of the forearm and leg, it is better to tie the brachial or femoral trunk, and establish a moderate compression on the wound.

These rules, moreover, apply to torsion, crushing, &c., when it is judged fit to have recourse to them in preference to simple ligature.

(2.) *False Aneurisms.*

The methods are the same as for simple arterial wounds, *compression* or *ligature*; only it is more difficult to find the vessel because of the clots of blood that fill the cellular tissue.

But in cases where it has been necessary to tie the artery above the wound, should an issue be given to the effused blood by a special opening? The question is important, and cannot be resolved generally. When there is little blood effused, the opening is without danger, but also hardly necessary, and we may hope for re-absorption.

When the effusion is enormous, it is with difficulty re-absorbed, but the opening often gives rise to inflammations of a bad kind (Pelletan). If the sac communicates with the exterior by a wound that remains open, the opening should be enlarged to give the blood and pus free exit. If the wound is closed of itself, or we can hope that it will close, we should wait, and see if it will not be absorbed naturally. It is only in cases where this hope is gone, and where suppuration takes place, that the sac should be largely opened and completely emptied; dress the surface, and, above all things, avoid any collections of pus.

(3.) *Varicose Aneurism.*

Four methods.

1. *Compression on the Tumour*, continued during several months. It may be employed with success when the tumour is recent, small, and superficial.

2. *Ligature above the Tumour*.—In three subjects operated on by ligature of the brachial, the tumour re-appeared (Dupuytren, Breschet); in two others, where the femoral was tied, gangrenous eschars and hemorrhage came on, and they died. This plan is then rejected.

3. *Ligature of the Artery and Vein*.—Proposed by Dupuytren, not yet tried on the living subject, but which leaves us in dread of phlebitis.

4. *Ligature of the Artery above and below the communication. Proceeding generally adopted*.—The rules do not differ from those we have given for cases of simple arterial wounds: only we should remember that chronic irritation has hardened the cellular tissue, changed the aspect of organs, multiplied adhesions, &c., and that the operation is long and delicate, especially isolating the artery without including the nerve or collateral veins with it.

SECTION III.—OF SPONTANEOUS ANEURISMS.

Setting aside the treatment of Valsalva, which is purely medical, and which by itself has perhaps never produced a cure, we may divide into three classes the means proposed for aneurisms, according as they are applied on the tumour itself, or on the arterial trunk above or below it.

(1.) *On the Tumour itself.*

1. *Topics, Styptics, and Refrigerants*, with the object of coagulating the blood in the tumour and thus obtaining its obliteration. Joined to the method of Valsalva, this plan has had some success.

2. *Mediate Compression*, with bandages and compresses. Little used.

3. *Electro Puncture*.—Advised to be done by means of a needle plunged into the tumour, and with the view of coagulating the blood. It has not yet been employed on the living subject.

4. *Incision*.—After establishing a compression on the artery, the sac is largely opened and emptied of the blood it contained; then compression is made by means of lint, &c., placed in the sac itself (Guattani, Sabatier); or the artery is raised with a female catheter, introduced first into its upper and then into its lower end, and one or more ligatures are placed on it above and below the sac.

(2.) *Above the Tumour.*

I. **MEDIATE COMPRESSION**, either directly on the artery or on the limb.*

* Compression above the tumour has lately been strongly recommended. Dr. O. B. Bellingham, in a paper published in the Dublin Journal, May 1845, gives a list of twelve

II. IMMEDIATE COMPRESSION, the artery being first laid bare. Some have used for this purpose two plates of wood tightened together by a thread (Desault); a plate of lead bent up (Percy); fixed forceps, differently modified; divers instruments for holding arteries (Assalini and Deschamps); a roll of linen or dressing (Scarpa), &c.

This last is the only one that still reckons any partisans. We shall describe it.

Proceeding of Scarpa.—The artery is laid bare as usual, only the division of the aponeurosis and sheath should be more extensive. A flat ligature being passed under the artery, place on it a small cylinder of linen covered with dressing, and secure it by two knots moderately tightened. Let the ends of the threads hang outside. Three or four days afterwards if the patient is healthy, five or six if he is of a bad constitution ("cacochyme"), or if the artery appeared diseased, remove both the ligature and cylinder.

To effect this, several means have been proposed. Scarpa prefers the following. He used a director slit at its extremity, and furnished with two small flattened rings on one of its lips, one near the point, the other near the handle. He passed one of the ends of the thread through these rings, and thus surely guided the point of the director on the cylinder and under the knot of the ligature. He then cut it on the director with a bistoury, covered with lint to within two or three lines of its point, and withdrew it gently, carefully avoiding all strain on the artery.

III. LIGATURE. *Method of Anel.*—It should be applied as far from the aneurism as possible, but without sacrificing any of the collateral branches. Thus for popliteal aneurism, Hunter tied the femoral artery in the middle of the thigh. In the present day we, with Scarpa, prefer tying it in its upper third.

Moreover, all kinds of ligature have been tried, vegetable and animal, mediate and immediate, simple and double, permanent and temporary, ligature with suture of the artery, double ligature with section of the vessel in the middle, &c. Generally, simple ligature is preferred. We have given the rules for it before.

cases (nine of popliteal and three of femoral aneurism) cured in this manner between Nov. 1842 and Feb. 1845. He states, "the aneurismal tumour in a few instances was of very large size, and in a few the operation by ligature would very probably have failed, owing to the diseased condition of the vessels, or some other cause. In one of these (Dr. Cusack's last case of popliteal aneurism), the tumour was of large size, the circumference of the limb at its seat being five inches and a half greater than on the opposite side; its parietes were so much thinned that great apprehensions were entertained lest they should give way; the limb was likewise œdematous. In Mr. Liston's second case of femoral aneurism cured by compression, the aneurism is said to have been no less than sixteen inches in circumference." The instrument Dr. B. recommends for making the pressure "consists of an arc of steel covered with leather, at one extremity of which is an oblong padded splint; the other extremity terminates in a nut containing a quick-screw, to which a pad similar to that of a tourniquet is attached. The compression should not be carried even so far as completely to intercept the circulation in the artery at the point compressed; the consolidation of the aneurism will be more certainly and more quickly brought about, and with less inconvenience to the patient, by allowing a feeble current of blood to pass through the sac of the aneurism. Compression by means of two or more instruments, one of which is alternately relaxed, is more effectual than by any single instrument."

IV. TORSION (*Thierry*) consists in raising the artery with the needle of Deschamps, which is then used as a "garrot," to twist it several times in the same direction, viz. four turns for a small artery, six for a middle-sized one, and eight or ten for more voluminous trunks. It has not yet been tried on man, and it would too much expose the artery to be torn, unhealthy as it frequently is in the neighbourhood of the tumour.

V. TURNING BACK THE ARTERY ("Le rebroussement").—Tried once unsuccessfully by Amussat.

VI. ACUPUNCTURE. *Velpeau*.—Tried on dogs with signal advantage.

VII. CRUSHING INSTRUMENTS ("Les Machures"), which, joined to ligature, appear to us to deserve more confidence than any other method.

We have sufficiently explained these several proceedings in the article *On the Suppression of Hemorrhage generally*, so that we need not return to them here.

(3.) *Below the Tumour.*

COMPRESSION AND LIGATURE—*Method of Brasdor*—have been tried sometimes with success, but generally with an unhappy termination. All we can conclude from these facts is, that we ought not to think of it when we can reach the artery above, but that when every other means is impracticable, and there are no collateral branches between the tumour and situation where we might place the ligature, tying above the tumour is an extreme resource, to which, under certain circumstances, the surgeon may resort.

CHAPTER IX.

OPERATIONS PERFORMED ON THE BONES AND ARTICULATIONS.

We shall treat successively—1. Of operations on the articulations; 2. Of operations affecting the continuity of bones. As to resections, on account of their mixed character and importance, we shall devote a special chapter to them.

SECTION I.—OF OPERATIONS PERFORMED ON THE ARTICULATIONS.

(1.) *Hydrops Articuli.*

When we decide on giving issue to an effused fluid we may choose between puncture with the trocar, and incision with a bistoury. Puncture gives less opportunity for the entrance of air, but the opening quickly closes, and the liquid is soon reproduced. Boyer prefers incision, made as follows—Choose the most prominent and most depending part of either side of the articulation; stretch the skin in the contrary direction to that in which the bistoury passes; plunge in the

bistoury perpendicularly, and whilst withdrawing it, enlarge the wound, which, however, should always be of small extent. When the liquid has run out, let go the skin, and it, in returning to its place, covers the opening in the capsular ligament. The wound must be covered with a bit of dressing, and the joint surrounded with linen moistened with a lotion, to promote resolution. Twenty-four hours afterwards, again evacuate the liquid that has collected. If the edges of the wound already adhere, open them with a probe. If the swelling has too much narrowed the opening, enlarge with the bistoury and director. We may even, in order to prevent reunion, put a bit of lint between the edges of the wound.

Emollient injections are very useful to wash out the pus that remains in the recesses of the articulation, or even if kept in after the method of M. Recamier, they might perhaps be beneficial.

Frequently this operation causes abscesses in the neighbourhood of the joint. They must be opened in the ordinary manner. When several openings in the joint itself have been necessary, Boyer recommends the seton made to cross the articulation; he afterwards, however, relates a case in which a director left in the joint caused very serious accidents.

When we have succeeded in curing the effusion and have closed the wounds, the articulation is at first stiff, and never entirely regains its accustomed suppleness, therefore most surgeons have rejected this operation as too dangerous. Very few even dared to try puncture, when I, some years ago, in the third edition of this book, proposed it as perfectly innocent. I had then had occasion to perform it six times, twice on the same patient, and always for hyarthrosis of the knee; and since then I have also had recourse to it. It is never followed by the least accident, but the liquid reappears quickly unless we have recourse to other means at the same time.

(2.) *Foreign Bodies in the Joints.*

They may be developed in all the joints, but are found principally in the knee. Compression and extraction are employed.

I. COMPRESSION.—It consists in bringing the foreign body to a part of the articulation in which it causes no pain, for example, in the knee, above the patella, and fixing it there with sticking-plaster and bandages (Middleton), or by means of a knee-pad well bolstered and exactly fitted (Gooch). Some cases of success are mentioned; either the foreign body had contracted adhesions, or was retained by a kind of juxtaposition.

II. EXTRACTION.—Extraction for a long while was made through a large incision, which, allowing the air to enter the joint, frequently caused serious and even mortal accidents; but the generalization of the subcutaneous method suggested to Goyrand a very ingenious plan, and one that certainly deserves preference whenever it can be put in practice. We shall commence by describing the ancient proceeding.

Ancient Proceeding.—Place the patient on the edge of his bed corresponding to the affected knee, the leg extended and placed on a pillow. Seek the foreign body, and bring it first to the superior part

of the articulation above the patella, then to its inside as near as possible to the attachment of the capsule to the condyle of the femur. If this cannot be effected, tell the patient to make those movements of the limb in which he has remarked the body to be carried to this point. If it is more easy to draw it to the outside, make the incision on this side. Lastly, if we cannot draw it either inwards or outwards, the operation must be put off to a more favourable opportunity.

The foreign body being then conveniently situated, the operator fixes it between his left finger and thumb, has the skin drawn forwards and outwards by an assistant, and makes an incision an inch long, in the direction of the limb, dividing both the skin and capsular ligament: if the incision of this last is too narrow, enlarge it so that the body may escape without contusing its edges. Often the body escapes of its own accord beneath the pressure of the fingers, if not, extract it with a curette or spatula, avoiding to bruise the parts that compose the articulation. Lastly, if it adhere to the capsule by a fibrous or other prolongation, draw this kind of pedicle outside and cut it with a scissors. Sometimes two or more of these bodies are found. Extract them one after the other. But if they cannot be brought to the incision without much difficulty, or the introduction of instruments into the articulation, it is better to leave them and extract them afterwards by a second operation.

The extraction effected, allow the skin to return to its place. The incision in the capsule of the joint is thus closed, and shielded from the contact of the air. The external wound is united by adhesive plaster, and wet lint applied outside, with compresses and a circular bandage. Keep the leg extended, and if we fear any movement on the part of the patient let a splint be put in the hollow under the knee to prevent flexion.

Bromfield drew the skin downwards, B. Bell upwards, Desault forwards, from the side of the patella. The choice between these proceedings is of no consequence. Even the precaution of drawing aside the skin at all is not so important as is supposed, since the wound should be united by first intention. It is, however, more prudent to practice it.

I cannot well understand the use of extending the limb after the operation. This position is more painful, and more exposes to stiffness than moderate flexion. The wound being well closed, a slight flexion with immobility of the limb seems to me preferable.

Proceeding of M. Goyrand.—The patient lying down, the operator standing on his left pushes the foreign body into the external part of the superior cul de sac of the patella, where he fixes it one inch and a half above this bone, and continues to press it from below upwards with the left finger and thumb. He then causes an assistant to raise a transverse fold of skin on the thigh over the spot, so that a portion of skin from a long way off is brought over the body; then with a sharp narrow bistoury two and a half inches long and only two lines broad at its base, he pierces this fold at its base from above downwards, directing its point towards the foreign body. He incises under the skin, parallelly to the axis of the limb, all the tissue covering

the body. He must do this three times to divide all the tissues; after which, he feels the body slip from his fingers: it has escaped from the articulation; then withdraw the bistoury and let go the folds of the skin. Some drops of blood mixed with bubbles of air, come from the wound, which will be nearly three inches above the point where the synovial membrane was divided; some globules of air also remain in the cellular tissue beneath the puncture.

The foreign body is now lodged between the middle and external portions of the triceps, two inches above the incision into the synovial membrane. Compression should be established below it, as much to prevent its return as to cause reunion of the subcutaneous incision. This compression may be removed the sixth day.

Some days after he performed the operation, two other foreign bodies having appeared in the joint, M. Goyrand repeated the same operation for one of them sixteen days after the former operation, only making his incision a little inside the first, and incising the triceps and fascia sufficiently to allow the foreign body to come under the skin. Though he did not succeed as well as he hoped, at all events he brought it under the fascia. Eleven days afterwards, presuming that all communication would be closed between this last body and the synovial membrane, he extracted it by an ordinary incision, but would not try the same operation for the other body which remained under the vastus externus; and he thinks it better to confine one's self to dislodging them from the articulation, leaving them in the cellular tissue, where they become encysted and give no inconvenience.

(3.) *Of Anchylosis: creation of an Artificial Joint.*

Generally anchylosis is treated by exercise and topical remedies or by apparatus, and needs no operation properly so called. However, Dr. J. R. Barton of Philadelphia has opened an entirely new way to science by forming instead of the anchylosed joint an artificial one. He performed the operation for an anchylosis of the femur at the hip-joint, on the 22d November, 1826, in the following manner:—

The thigh was bent at a right angle on the pelvis, the knee turned inwards, and carried towards the healthy thigh so that the outside of the foot was turned forwards.

He first of all made an incision five or six inches long, beginning half an inch above the great trochanter, only dividing the skin; then a second transverse, four inches long, crossing the first over the most prominent part of the trochanter major, converting it into a crucial incision. The four angles were dissected and reflected, the fascia divided, and the muscles covering the trochanter carefully detached, avoiding unnecessarily cutting the muscular fibres. After having isolated the bone in front and behind the trochanters, and made a passage that admitted the two index fingers before and behind the neck of the femur, till they met and circumscribed the bone, a strong narrow saw was used to divide the bone through and through, commencing outside and in the middle of the great trochanter, and ending inside towards the inferior part of the neck of the femur, a little above its implantation on the body of the bone. The operation lasted only

seven minutes. There was no vessel to tie. The thigh was everted, the knee turned out, and the entire limb extended by means of the apparatus of Desault. The wound was closed by strapping and compresses. The affected limb, compared with the healthy, was half an inch shorter.

From the twentieth day, the patient being well enough, the limb was cautiously moved; on the sixtieth the wound was healed; the patient got up, supporting himself on crutches. Forty days afterwards he could walk, the motions of the new joint being free. The foot could be carried forwards twenty inches, backwards twenty-two, outwards seventeen, and by rotation inwards five. The shortening was slight, and did not even occasion limping.

Perhaps in an urgent case it would be better to introduce through a narrow wound a steel chisel, on which one might strike with a leaden mallet to break the bone without exposing it to contact with the air. However, I should not like to have recourse to this operation unless in a very urgent case.

For complete ankylosis of the knee, M. Louvrier invented a machine strong enough to break the osseous union by a sudden movement of the limb. The fracture was then altogether out of the way of contact with the air; but nevertheless, after some instances of success, such sad reverses happened that this machine is actually fallen into complete oblivion.

(4.) *Luxation.*

The common reduction of luxations is not generally classed amongst surgical operations properly so called. We will not contravene this usage.

There remain for the operator cases of old luxation in which the ligaments and muscles may be cut, either by ordinary or subcutaneous incisions; and still severer cases where the articular end of the bone has protruded through the torn integuments so as to render reduction impossible. In this case it has been advised to cut off the projecting end of the bone. But division of the muscles has not as yet afforded positive results, and the circumstances of the accident must determine as to the performance of resection. I shall speak of all that concerns these doubtful operations in the *Treatise on Fractures and Luxations*, which I am now publishing.

(5.) *Articular Caries.*

For this affection, the resections treated of below were invented.

SECTION II.—OPERATIONS PERFORMED ON THE CONTINUITY OF THE BONES.

In operating on the osseous tissues, we require different instruments to those used for dividing the soft parts. We may reduce these instruments to four classes, according to their mode of action.

A rule common to all is that the bone operated on should be solidly and firmly fixed in position, generally on a solid plane; if a long bone, it should be held firmly by both of its extremities.

I. THE SAW.—Many kinds are described. 1. According to their thickness, from the fine watchmaker's saw, which serves for the teeth and phalanges, to the large saw for amputations. 2. According to their shape; the straight, the cock's-comb saws, or those with a convex sawing edge; the versatile saw of Scultet, the circular saw or trepan, and the articulated saw; the osteotomis of Heine, of Lesguillon, of Charrière, &c.

The straight saw is held in different ways, according to the shape of its handle, but always in a firm grasp, so as not to vacillate. We commence by tracing a groove on the bone, causing the teeth to act obliquely, and directing it with the nail of the thumb of the left hand. The track being well assured, turn up the saw so that it act perpendicularly or in the direction indicated by the disease. Cause it to act in large sweeps to almost the entire extent of the blade, avoiding ever to strike the bone with the handle. Press on the saw in pushing it forwards, leave it to its own weight in drawing it back. In making these alternate movements, use the arm so that the elbow advances and retires with the saw. As the division of the bone proceeds, act more lightly and with smaller sweeps. It is of great importance when a long bone is divided that the assistants who hold the ends of the bone keep them parallel; for if they incline them to either side, or together, or too much apart, either the saw is held, and hindered from moving, or the division gapes too much and the bone splinters.

Many surgeons recommend another mode of action, which consists in maintaining the arm immovable, or nearly so, close to the trunk, and executing the forward and backward movements by flexion and extension of the forearm. The position of the operator thus appears more graceful and less constrained. A more sensible advantage is, that it occupies less space, when we need several assistants to hold the patient; we should then practice both plans.

The cock's-comb saw moves in the same manner. It is less easily guided, and is only used in sawing portions of bone where the straight saw is inapplicable.

The versatile saw of Scultet, almost forgotten in France, might still be of some use in certain cases of resection.

The trepan will be specially examined farther on.

The articulated, or chain-saw, has this advantage, that its edge will take any curve required, and may be passed under the bone to saw it from within outwards. The operator holds one end of it, a skilful assistant the other, and they give it a forward and backward movement, carefully acting together.

II. CUTTING FORCEPS.—These are, in fact, scissors, only varying in size and shape. They act always by a double pressure. They are called resecting forceps.

III. THE PERFORATOR.—A sharp pyramid, with three or four angles, moved like the trepan, which, by making holes in several points of the bone, renders it more easy to be cut by other instruments.

We may class among perforators the trepanning needle of Weinholt, of which we shall speak hereafter.

IV. INSTRUMENTS WITH A PLAIN EDGE.—The rasp, only used to scrape the periosteum, or at farthest some softened portions of bone; the lenticular knife, which is grasped firmly to level the section of the saw; the chisel and gouge, used alone, or with a leaden mallet. Lead is preferred to iron for this mallet, because it is less elastic, and communicates less shock to the bone to be divided. In order that the chisel pierce well, an inclination of 45° should be given it.

The saw is the only instrument we can use to cut through a compact cylinder of bone; the chisel would not be powerful enough; the resection forceps would splinter the bone. These forceps, like the scissors on soft parts, only suit for cutting thin and spongy portions of bone. For the spongy tissue generally, the chisel cuts cleanest, and with least contusion, and should be preferred.

(1.) *Of Trepanning, or the application of the Trepan.*

The instruments necessary for this operation are—1. One or several trepans, mounted on a drilling-handle, called the *French trepan*, or more simply on a shank with a cross handle, which constitutes the *English trephine*. 2. A perforator, to screw into the centre of the trepan, and removable at pleasure. 3. A kind of double screw of steel, and very strong. 4. A lenticular knife, with a very strong blade, and a large button at its point. 5. A rasp. 6. A small brush, to clean the groove in the bone.

The part operated on should rest on a solid surface, such as a board covered by a cushion, and be held by assistants. Lay bare the bone, and rasp it in the place where the instrument is to be applied. If you use the trepan, arm it with its crown and perforator; then with the right hand hold it as a pen, place the point of the perforator in the centre of the piece of bone to be removed, grasp the plate at the end of the handle with the left thumb and index-finger, and press on this plate with the forehead or chin. Grasp the middle of the handle with the right hand, and turn the crown and perforator from right to left, leaning gently. The perforator first makes a hole, the teeth then soon touch the bone, and trace on it a circular groove. When this is deep enough to prevent the crown from slipping, remove the perforator, and make the screw penetrate two or three turns in its place, to afford afterwards a firm hold; then continue the operation with the crown alone, quickening the movement of rotation. Take care that it acts equally on all parts of the circle, and withdraw it from time to time to satisfy yourself on this point; at the same time brush out the groove, and clean the teeth of the crown. When you think you have nearly traversed the bone, act more slowly, and feel frequently with a pen if the bone is not pierced through in any part of the groove. If this is not the case, try to loosen the osseous disc, and withdraw it with the screw. When it is completely detached, a very distinct cracking sound is heard; then withdraw the trepan, and sometimes the disc of bone comes away in the crown. If not, apply the screw, or the end of an elevator used as a lever of the first order. If the section is clean, the operation is now finished. When there are prominent points of bone, remove them with a lenticular knife.

Sometimes one crown is not enough. In this case, apply the trepan at some distance, then with the cock's-comb saw make two parallel sections, and remove the portion of bone between them. Some surgeons prefer bringing the crowns nearer together, so that one section impinges on the other, and there only rest some angles between them, which are easily removed with the chisel or cutting pliers.

With the trephine the operation is more simple. It is first applied with the perforator, and by movements of rotation right to left, and left to right, accompanied with suitable pressure, a groove is made for the crown, the perforator is removed, and the operation continued with the crown until the section of the bone is complete. The other rules are the same.

The trepan is applied to the cranium, sternum, and to the tibia, in cases of sequestrum. The scapula has also been trepanned, the os coccyx, the inferior maxilla, &c. The operation only differs in these cases according to the greater or less depth and density of the bone. We shall restrict ourselves to speaking of the trepanning of the cranium.

TREPANNING OF THE CRANIUM.—We may trepan on all the accessible points of the cranium. The sutures, the frontal sinuses, or the presence of the temporal muscle, are no longer obstacles with modern practitioners. But we must avoid touching the confluence of these sinuses opposite the occipital protuberance, and in general go as far as possible from the thickest points of the cranium, from the course of the venous sinuses and middle meningeal artery.

The patient lying down, his head resting on a board covered by a pillow, and firmly fixed by an assistant, make a V, T, or X incision through the integuments, dissect back the flaps, cover them with very fine linen, and give them to an assistant to hold; then scrape away the periosteum, and apply the trepan as described.

Some have said that it is easy to recognize when we have perforated the diploe by the redness of the groove caused by the saw; and again, when we have reached the internal table, by the whiteness and dryness of the bone dust. This distinction holds good on the subject, but on the living patient the blood continues to flow from the diploe, and prevents our drawing any inference. The more rapid progress of the saw in the diploe has also been vainly given as an indication. But, to judge of the distance we are from the dura mater, we have no other resource than frequently measuring the depth of the groove with the end of a pen, and especially examining whether the bone is perforated in any one part of the circle before the other. The disc of bone having been removed, and the edges levelled with a lenticular knife, the operation may be continued according to the end proposed. If we want to raise bits of depressed bone, slip an elevator between the cranium and dura mater, without dividing that membrane. If an effusion exists beneath, divide it longitudinally or crucially very carefully; carrying the point of the bistoury perpendicularly on it.

Dupuytren did not fear, in an urgent case, to plunge his bistoury even into the cerebral substance, to more than an inch in depth.

The mode of dressing varies. If the external wound must be left

open on account of some effusion, carry into the sac a very thin band of linen, cover the wound with a bit of linen riddled with holes, in the same way as an ordinary wound, taking care not to pass this linen between the bone and dura mater, as some advise. Some lint over that, with compresses and a moderately tightened bandage, complete the dressing.

If there is no effusion, reunite the flaps by first intention, by means of adhesive plaster.

Some authors have gone farther, and recommend closing the opening in the cranium with a bit of bone cut out of the head of a dog by a crown a little larger than that which was used for the patient. A rash practice, of very doubtful utility, notwithstanding some cases of success that have been reported.

If the operation has been performed on a young subject, the dura mater may secrete a substance that becomes ossified, and forms an actual plug; but in the greatest number of cases there remains an opening in the bone, by which we can sometimes feel the motions of the brain. Some advise, in order to prevent the action of cold on this organ, or to hinder hernia of it, that the cicatrix be covered with a thin plate of leather or soft pasteboard. We have seen several individuals who have been trepanned, without these inconveniences.

Certain portions of the cranium, when trepanning is necessary in them, demand special mention.

1. When we trepan on the temporal fossa, Sabatier advises making a V shaped incision, the base upwards, in order to respect the fibres of the temporalis muscle. Velpeau very properly remarks, that by so doing we cut, just the same, all the fibres comprised in the base of the flap. To respect these fibres as much as possible, we would advise making two incisions in the direction of the muscular fibres, and reuniting them inferiorly by a transverse incision, so as to form a V incision reversed, and cut off at the top; on the one hand, the division of these fibres, and the cicatrix that results, are less extensive; and on the other, the transverse incision, affecting more or less the deep aponeurosis on which most of its fibres terminate, we should divide really less muscular fibre.

2. When we have to traverse the frontal sinus, the internal table of the bone not being on the same plane as the external, in performing the operation as usual, the dura mater would be torn at one point before the second table was cut through at the opposite. To cut the second table, then, a smaller crown should be used than that employed in sawing the first.

3. When we trepan on the sagittal suture, or opposite the venous sinuses, we run a great chance of opening them; the hemorrhage generally stops of itself, or yields to a little plugging.

4. Lesion of the middle meningeal artery is more serious, on which account it has long been forbidden to trepan, at the anterior inferior angle of the parietal bone, under which the artery lies. If hemorrhage occurs, it may be compressed with a bit of lint placed inside the cranium, and retained by a thread outside (Physick); or with a plate of lead, bent so as to embrace both surfaces of the bone; or it

may be plugged with a bit of wax, if it is shut in a complete bony canal; or touched with a steel probe heated to whiteness (Larrey); or even tied, in which Dorsey once succeeded.

(2.) Of *Exostosis*.

Anatomy.—Sir A. Cooper distinguishes, 1. *Medullary cartilaginous exostosis*, in which a cartilaginous mass is developed in the bone itself, covered externally by an osseous layer, which layer is either the external layer of the bone spread and developed, or a new formation.

2. *Cartilaginous periosteal exostosis*, which consists, on the contrary, of a cartilaginous mass, developed between the bone and periosteum, in which ossification begins on the side next the bone, and in the interior of the tumour.

3. *Fungous exostosis*, either *periosteal* or *medullary*, which others have called *osteosarcoma* or cancer of bone, tumours of the most serious nature.

Periosteal exostoses are at first “*épiphysaires*,” that is to say, next the surface of the bone, and without solid attachments; afterwards they form osseous adhesions, and are then called *cimentées* (Rognetta).

Operative Proceedings.—When we have to do with a medullary cartilaginous exostosis, we lay it bare like any other tumour; destroy its osseous shell with a saw, trepan, perforator, or scissors, and with the elevator turn the cartilaginous mass from the cavity it occupied (A. Cooper).

The exostosis “*épiphysaire*” is removed as an ordinary tumour; when it is “*cimentée*” we use, to separate it from the bone, the saw, or chisel and mallet. When it offers a narrow pedicle, one horizontal cut with a saw is enough; but if it has a large base, the best way is to attack it in several parts, either by perforations numerous and close together, or, better still, dividing it perpendicularly by several cuts with the saw, crossed in different ways. It is then easy to remove each portion by a transverse cut at the base, or by the gouge and mallet.

The saw is best for exostosis of the cranium, where the mallet would cause too great a shock. In most cases the skin and flesh are divided according to the ordinary rules, avoiding nerves and vessels. In a case where an exostosis with a narrow base was situated under the deltoid, Roux made two incisions, almost parallel, in the direction of the fibres of this muscle, isolated the tumour below the point that separated the two incisions, and sawed its base through without cutting the muscle across.

In fungous exostosis several methods are advised.

1. They may be destroyed in the ordinary way, but the operation should be finished by the application of the actual cautery to all the parts of the bone from which the fungus arises. This is the common way, but it is bad, inasmuch as the extirpation does not reach the healthy parts.

2. The tumour is left untouched, and the healthy osseous tissue cut at some distance from its base. This is the plan of Gensoul for fungus of the maxillary sinus.

3. Lucas and A. Cooper tried ligature of the main artery of the limb without success.

4. Further, we may have recourse to extirpation of the bone itself, partially or totally, and as a last resort, to amputation.

(3.) *Of Serous Cysts and Hydatids developed in Bone.*

We unite these two affections, because, on the one hand, it is impossible to distinguish them before operating; on the other, the treatment is the same.

Three proceedings have been tried.

I. COMPRESSION.—Forster tried compression with sticking plaster; a purely palliative plan, which only momentarily diminishes the volume of the tumour.

II. INCISION.—Lucas incises the tumour, to dislodge from it the hydatids. Other accidents obliged him to amputate. But Dupuytren, who also tried incision on serous cysts, observed that the opening became obliterated, and the cyst re-appeared. This plan, then, should also be rejected.

III. EXCISION (*Dupuytren*).—A thick strong bistoury is plunged into the lowest part of the tumour, laid bare by incision of the soft parts, and an incision, one or one and a half inch long, according to the volume of the tumour, made through the bony shell; then, with the same bistoury, or with strong scissors, or, if needful, cutting forceps, two oblique incisions are made, cutting out a triangular bit of bone. The cavity is filled with lint, to excite suppuration of the internal wall of the cyst; afterwards, irritating injections are used, and retraction of the parts favoured by appropriate compression.

(4.) *Of Caries.*

We understand by this term, gangrene, with softening of the osseous tissue. (A memoir we published on this subject in the *Archives Générales* may be consulted.)

It is treated by caustics, actual cautery, and résection.

I. CAUSTICS.—Begin by laying bare the entire extent of the caries, passing even a little on the healthy parts of the bone, and removing all the vegetations covering it. If this first step of the operation causes much pain or hemorrhage, dress the caries with dry lint. The next day observe the quantity of pus; there should not be at farthest more than enough to moisten the lint; if all the dressing is soaked, it is certain that this abundance of matter comes from some concealed sinus, either in the bone or soft parts, which it is important to discover.

If the caries is very superficial, slight cathartics suffice—tincture of myrrh or aloes, powdered euphorbium, &c. If it is deep, and especially if complicated with advanced ramollissement (called “vermoulure”), energetic caustics are required. *Monro* preferred caustic potash to the actual cautery. *J. L. Petit* preferred the nitric oxide of mercury.

He removed with a rasp all the decayed portion of the bone, to reach the boundaries of the disease, and then applied a dossil of lint,

dipped in the liquid, on the bone ; guarded the rest of the wound with lint, and maintained all by suitable bandages. One application is not enough ; it should be repeated until sanious matter no longer exudes from the pores of the carious bone, that is to say, until the dossil and bone remain almost dry, which indicates that we have penetrated to the healthy part of the bone. Petit often obtained a complete exfoliation by this means in fifteen or twenty days.

Monro advises cauterizing from the beginning, the soft parts of the ulcer, so as to render them insensible to the subsequent applications. J. L. Petit recommends removing them in the whole extent of the caries. Modern practitioners are content with dissecting the flaps far enough to secure them from the action of the caustics.

II. THE ACTUAL CAUTERY.—Lay bare the caries, and remove in the first place, with a gouge, rasp, or the mallet, all you can, so that the heat may act more readily on the healthy part of the bone. Stop when you recognize the healthy tissue and colour of the bone, or when some drops of blood escape from the vessels divided. The wound should now be dressed with dry lint ; and the next day, all hemorrhage having ceased, the cauterization may be proceeded with. Above all things, the neighbouring parts should be guarded from the action of the cautery. Petit covered them with wetted compresses, or conducted the cautery through a tin tube ; but the simplest and safest method is that which Percy adopted from Camper.—Some card-board, about one line thick, well rolled and glazed on both sides, should be cut to fit, according to the depth. By means of folds it takes a square or lozenge shape, according to the figure of the wound. When the edges of the wound are elevated, the card-board is retained by its own elasticity ; if not, it may be held by dressing forceps, &c. Its edge should rest on the surface of the bone, and fit it well, otherwise it might allow the boiling fluid, sometimes caused to exude from the bottom of the caries by the cautery, to pass beneath it.

The cautery should be applied by degrees—the first time only lightly, to calm the fears of the patient. If possible, he should not perceive the heat. In the following applications you must lean heavier, especially on the places where the caries is thought to be deep. When the first iron is cooled, take a second. When the heat is felt deeply, it is a sign that you have reached the healthy portion of the bone. If this sensation continues some hours after the operation, the cauterization has been sufficient ; but if, on the contrary, it almost immediately ceases, you must once more repeat the application, but with caution, immediately removing the cautery when the patient complains of a more severe sensation of burning than he has before experienced.

Five or six days after the last application, the edges of the osseous eschar separate from the flesh. From the tenth to the fifteenth day, if the finger be pressed on the middle of the eschar, the patient experiences a sensation of pain. This is a certain sign that the bone is separating, and that granulations are springing up. When these signs are not present, we conclude that the cauterization has not been sufficient. We generally wait until the 25th day, to give plenty of time

to nature ; but this time passed, we re-apply the cautery, according to the principles laid down. If the edges of the wound pour out too much matter, repress it by dry dressing, or applying from time to time calcined alum, caustic potash, or a solution of nitric oxide of mercury, diluted with infusion of plantain, &c. (J. L. Petit.)

III. RESECTION is performed with the trepan, different kinds of saws, rasps, and the chisel and mallet. The only rule is to completely remove all that is diseased. The most important resections will be treated of farther on.

Appreciation.—Caustics and the actual cautery transform the caries into a dry eschar, the exfoliation of which we must wait for. Resection immediately lays bare the sound portion of the bone, from which spring healthy granulations. This latter, then, is the quickest, and is also the only method to be employed for bones near the viscera and joints, which might be injured by the action of the cautery. We are sometimes obliged to have recourse to it before putting cauterization into practice. Caustics are only suitable when the caries is slight and superficial. The actual cautery is always more efficacious.

(5.) *Of Necrosis : Extraction of the Sequestrum.*

Pathological Anatomy.—When all, or part of the thickness of a bone has been necrosed, a new osseous tube forms around it, and incloses it on all sides, unless where part of the old bone was exposed to the air. Across this shell small holes are eaten, by which the matter escapes, and which are called *cloacæ* (Weidmann). The piece of bone thus inclosed has received the name of *sequestrum*. The new bone passes through the ordinary steps of ossification, from the fibro-cartilaginous to the ebony—whence this important consequence, that we should not try extraction of the sequestrum too early, lest the new bone, as yet soft, should become deformed by muscular action ; nor too late, lest it arrive at the state of ebony, and offer an excessive resistance to the operator (Bousselin).

Operation.—Choose beforehand the spot where the soft parts are least thick, and where the largest openings of communication between the sequestrum and exterior exist. If there are several of these *cloacæ* ranged in a vertical line, it is sufficient to remove one or more of the kind of osseous bridges that separate them ; if not, choose the largest of these openings, and that, nearest one of the extremities of the sequestrum. The most inferior is to be preferred.

The patient should lie down, with his limb resting in its whole length on a well-padded table, and exposing the part to be operated on. After again making sure of the disposition and mobility of the sequestrum, make two semi-elliptical incisions on the sides of the opening preferred, of suitable size, and joining each other so as to circumscribe a flap of skin, which remove. If much blood flows after this dissection, dress the wound with dry lint, and put off the rest of the operation until the next or a future day. Then enlarge the *cloacæ*, so as to get nearer one extremity of the sequestrum. If the bone is still soft, you may use a strong knife, if not the trepan or gouge. Make as many openings as you think fit with the trepan, and remove

the intervening shell of bone with the cock's-comb saw. This method is more gentle than with the gouge, and should be preferred if the bone has acquired any hardness. The end of the sequestrum being now laid bare, seize it with a strong forceps, turn it to one side and the other so as to detach it, and extract it without violence, for fear of tearing the membrane that covers the interior of the new bone. Sometimes we are obliged to lay bare the sequestrum in its whole length; in any case, take care not to break or bend the new bone. The sequestrum being removed, lightly dress the wound with lint, and treat it as a wound that should suppurate. When the cicatrix is perfected, but before the patient uses the limb, make sure that the new bone is solid, and the loss of substance sufficiently made up, to remove all fear of its breaking or bending. This recommendation is especially necessary with the lower limbs.

(6.) *Of Compound Fractures.*

They present but few circumstances that have any immediate connection with operative surgery—such as splinters of bone to be extracted—fragments to be sawed off when too sharp, or forming a projection across the soft part that opposes reduction. These operations do not require any special rules.

(7.) *Of Non-consolidated Fractures, or False Joints.*

Anatomy.—Generally we find the fragments united by an intermediate fibrous tissue. Sometimes there exists an articular capsule, and a new synovial membrane. At others the fragments, far apart, are separated by portions of muscle. A host of methods have been advised.

I. FRICTION.—Celsus would have the two ends rubbed together to irritate their surfaces, and the limb then put in an immovable apparatus.

II. COMPRESSION. *White.*—A strong envelop, forming a sheath for the limb, composed of thick leather, softened and moulded, is applied and tightly retained, by means of straps and buckles, around the limb, which the patient is made to use as much as possible.

Briot cites some successful cases, and Amesbury several, by this means. Simple compression, by means of a common fracture apparatus, with rest in bed, succeeded once with Boyer.

III. BLISTERS often renewed on the spot. They have been followed, according to Wardrop, by remarkable success.

IV. RESECTION.—Three proceedings:—

In all cases the fracture must be laid bare, by means of a longitudinal incision, made on the side of the limb least covered by flesh, and most removed from the vessels. Thus, in the thigh and arm on the outside—in the bones of the forearm and leg on the side nearest the integuments. When the fracture is exposed, divide the bond of union between the fragments, and luxate them outwards; then either you may only scrape off the cartilaginous envelop covering their ends (the ancient method seemingly derived from the Arabs), or cut off the osseous extremities themselves (*White*), or only one extremity (*Du-*

puytren); then place the limb in a fracture box, and treat it as a compound fracture.

Very recently, after a resection of this kind, performed on the humerus, Flaubert of Rouen, not being able to maintain the ends in apposition, reunited them by an actual suture, by passing a metallic thread across the fragments themselves. This idea seems to me very ingenious, and susceptible of many other applications; moreover the result of the operation was most satisfactory, and consolidation was duly obtained.

As for resection alone, it has had some success, balanced by a great many failures.

V. SETON.—Invented nearly about the same time by Percy, in Europe, and by Physick, in America.

Proceeding of Physick.—Extension, and counter-extension, are made by two assistants, so as to separate the two ends from each other and obtain a sufficient passage for the needle between them; a common, or if necessary, a curved seton needle is threaded with a band of silk, and passed through the limb, carefully avoiding the course of the vessels, and choosing as points of entrance and exit for the needle the parts least covered by flesh. It is essential that the needle pass well across the interval between the two fragments. Dress it at first as an ordinary seton, then, when suppuration is well established, place the limb in an apparatus for extension. In Physick's case (a fracture of the humerus) the consolidation did not begin until after twelve weeks. When the callus was so solid that all the motions of the arm could be executed, the seton was withdrawn, and the patient left completely cured after a treatment of five months and a-half.

Proceeding of Wardrop.—The articulation was in the thigh, four inches below the great trochanter. The surgeon, after having recognized the end of the upper fragment, made an incision one inch and a half long, upon and along the external border of the rectus muscle, down to the bone. He passed his finger to the bottom of the wound, and on it guided a button-pointed bistoury to cut the remaining soft parts, and expose the fibrous tissue joining the ends of the bone. Down to this he passed a sheath, containing a seton needle, which he pushed through the fibrous callus downwards and outwards, so as to bring it out at the border of the vastus externus. The seton put in, the remainder was performed as in the proceeding of Physick.

V. CAUSTIC POTASH. *Proceeding of Green.*—The articulation having been exposed by a sufficient incision, he divided the fibrous union, and rubbed each end with a bit of caustic potash, taking care that the caustic should not touch the neighbouring tissues. The cauterization is deep enough when the ends of the bone become blackish.

In another case Mr. Earle removed the fibrous tissue by scraping, so as to act on the bone itself.

Appreciation.—All these methods boast perhaps fewer successes than failures, which gives an indication to the surgeon that in non-consolidation, there is a primary cause that should be sought and destroyed, before we have recourse to operations, not without danger. This

was perhaps an inducement, when compression failed, for seeking a new method, which, with as many chances of success as the others, incurred still less danger.

New Method. Needles.—In 1837, I tried at the “Maison Royale de Santé” to introduce acupuncture needles between the non-united ends of a fracture of the inferior fourth of the femur; but although movable, the fragments were so close together, that of thirty-six needles introduced, at different points, I could not make one penetrate. I since, at the hospital “des Enfants,” met with a non-consolidated fracture of the condyles of the humerus, in a little girl two years old. But the fragments were so movable, and the patient so intractable, that acupuncture seemed to me to have no chance. Here, then, are two special contra-indications, for which we must have recourse to other means; but I think that in more favourable cases, the needles should be tried with so much the more reason, that the operation has no inconveniences.

(8.) *Vicious or Deformed Callus.*

Anatomy.—It too often happens, after bad treatment, that the bones become consolidated, with different displacements, or inequalities; that the bones of the forearm become consolidated together; and that the callus is of extraordinary size, or unshapely. It should be remembered that the callus has several stages; that it is successively fibro-cartilaginous, and osseous; and that even arrived at this last state, it again passes from the state of provisional to that of definite callus.

The duration of these stages is not the same in all the bones; but it is important to know, that after sixty or ninety days, according to the bone fractured and the nature of the fracture, the definite callus commences; and lastly, the farther we get from the time of the fracture, the more difficult it is to reform the callus.

Five principal methods have been proposed.

I. PERMANENT EXTENSION.—Made with common apparatus, or better with graduated orthopedic machines; when the fragments ride and the callus is still provisional, this is undoubtedly the best plan.

II. COMPRESSION.—Principally employed for angular displacements. It is made with ordinary splints, or with the hyponarthécic splint and bands of Mayor; or by different mechanical compresses, which it is not our object to describe. Its utility is also limited to the first stages of the callus.

III. RUPTURE OF THE CALLUS.—It has been proposed to rectify the angular callus, or deformity, by breaking it on the knee, as a stick; or striking sharply, with sufficient force, the place of consolidation. These violent measures are generally reprobated, and it would be better to use a chisel and leaden mallet, as I have advised in cases of ankylosis.

IV. SECTION OF THE CALLUS consists in laying bare the callus, and dividing it either with the common or chain-saw, or chisel and mallet; this is the only way of remedying consolidation of the bones of the forearm.

Proceeding of Wasserfuhr.—The case was a fracture of the femur,

at four fingers' breadth from the great trochanter, in a child five years old, consolidated, so that the two ends of the bone bearing upwards and outwards, formed a right angle, and that the limb was shortened *twelve fingers' breadths*. The callus was large and solid, and three weeks had passed since the accident. The operator having strongly extended the skin below, with his left hand, to make the angle still more prominent, made on the projection a transverse incision, comprising a quarter of the circumference of the thigh; in a second cut, the muscles were divided down to the bone. The retraction that followed, laid bare the angle of the callus; with a fine saw, he commenced dividing it to one-third of its thickness. The soft parts did not permit going any farther. As the operator contemplated finishing the division of the bone by fracture—considering that the fragments thus broken would assist the work of consolidation—he tried to break the bone, placing under the angle in the thigh, a wooden pyramid, with a rounded top covered with chamois leather, the base of which was fastened to the table; but, notwithstanding a pretty violent effort on the two ends, the callus resisted. He was obliged to cut the soft parts more freely, and again saw the bone more forwards. Then a second attempt at fracture succeeded. In the operation thus easily performed, in a few minutes, not more than 3x of blood were lost. Permanent extension was put in practice with complete success.

V. THE SETON. *Method of Weinhold*.—In a case of fracture of the femur, three months consolidated, with two and a half inches shortening, and an enormous callus, Weinhold mounted on a drilling-handle a needle, which he called “aiguille-trepan.” He pierced the soft parts about one inch outside the femoral artery; arrived on the callus, he caused the needle to penetrate it by a careful rotatory movement. When the callus was pierced, he pushed the needle through the flesh, and transfixed the limb. He then passed the seton. Very little more than one ounce of blood was lost. About the seventh week the callus began to yield, an extending apparatus was put on, and the limb was soon so elongated; that it was not more than one-tenth of an inch shorter than the other.

CHAPTER X.

RESECTION.

Of Resections generally.

WE comprise under this title the removal of the articular extremities of bones, the resection of long bones in their continuity, and, lastly, the extirpation of certain bones entire, without amputation of the soft parts.

First, let us establish some general rules.

1. Before commencing the operation, consider distinctly the anatomical displacement, which renders it much more difficult on the living than on the dead subject—the swelling of the bones—the induration and engorgement of the soft parts—and the difficulty of recognizing the nerves and vessels, which must be avoided. The operator, says Moreau, jun., has need of all his coolness, and the operation needs prudence to the exclusion of all timidity.

2. Besides the ordinary instruments, we must have in readiness cutting forceps, a gouge and mallet, and saws of different sizes and shapes, so as not to be at a loss if obliged to change during the operation.

3. One assistant should be always ready with water and fine sponges to clean off the blood, and enable the operator to recognize the colour of the bone.

4. In making the external incisions, a double object must be kept in view—to open a sufficiently convenient and free way to the bone, and to expose as little as possible of the muscles and tendons.

When a long bone is to be removed in its entire length, if a simple longitudinal incision does not suffice, I have proposed, as a general plan, to add two small perpendicular incisions at each extremity of the first, so as to obtain a quadrilateral flap.

5. The nervous, venous, or arterial trunks must never be divided.

6. The bone being laid bare, examine to what extent it is diseased. Even probe it with a gouge or pointed probe, to see to what depth the caries extends.

7. Before employing the saw, the soft parts must always be put out of danger by compresses, by more or less solid guards, or, more simply, by passing behind the bone the handle of a knife.

8. The first law is to remove completely every part touched by the caries. All the others are subordinate to this.

9. The second is to guard as much as possible the useful tendons and attachments of muscles. For this purpose, if the caries extends too far, pursue it with the gouge to the healthy part. It suffices to leave a very thin layer of compact substance for the muscular attachment.

10. When an articular surface is composed of several bones, they must generally be cut off at the same height, lest after the cure the obliquity of the section cause a deviation of the limb. This rule is especially important for the articulation of the wrist and instep.

11. If the resection is made on the continuity of a long bone, or even if the bone be entirely extracted, the periosteum must be preserved as much as the disease will allow. In children it may furnish matter for a new bone, and in adults it serves as the basis of a fibrous tissue, which to a certain extent supplies the place of the old bone.

12. The operation finished, unite the wound with adhesive straps, or, if necessary, the interrupted suture.

13. When you have operated on the lower limb, bring the bones together, and extend it; when on the upper, put it in a state of semi-flexion, and leave the bones a little apart, so as to obtain, if possible, an artificial joint.

Of Particular Resections.

We shall treat successively of partial and complete resection of the bones of the upper limbs, then of the lower limbs, and lastly of those of the trunk.

SECTION I.—RESECTION OF THE BONES OF THE UPPER LIMB.

(1.) *Resection of the Metacarpo-phalangeal Articulation.*

The articulations of the phalanges with each other are never resected. The consequent ankylosis would render the finger worse than useless. But you may remove, according to the case, either the head of a metacarpal bone, or the end of a phalanx, or both at once. If ankylosis comes on above the diseased articulation, we have still two movable joints. Make an oblique incision, commencing half an inch beyond the point at which you wish to apply the saw, from the middle of the dorsal surface of the metacarpal bone to the commissure of the finger, then another from the same point to the next commissure on the other side; thus circumscribing a V-shaped flap, with its base next the finger. Dissect back this flap, turn aside the extensor tendon, detach the inter-ossii from the sides of the bone, and open the joint, cutting its anterior and lateral ligaments carefully, not to wound the flexor tendons; then dislocate the phalanx backwards; and, after having well isolated the diseased portion from the soft parts, slip a bit of wood or card-board beneath it, and saw it off; then operate in the same way on the head of the metacarpal bone. If you would excise the articulation of the index, thumb, or little finger, it would be easier to cut the flap on the free side of the joint; and we might, according to the condition of the parts, make the base inferior or superior. In this way we need not put the extensor tendon so far aside to make room for the saw.*

M. Bohe resected the head of the first phalanx of the thumb in a case of irreducible luxation. This greatly removes the difficulty of the reduction.

(2.) *Extraction of the First Phalanx.*

This operation, which has not yet been tried, or even proposed, seems sometimes indicated, especially in the thumb. Velpeau saw the last phalanx preserve its motions after the first had been extracted in necrosed bits. An incision on the radial side of the thumb would suffice. You would dissect, preserving as much as possible of the periosteum, and commence by destroying the metacarpal articulation, looser than the other. The bone turned out, and completely dissected, the rest would be easy.

Velpeau has recently proposed to resect the middle portion of a phalanx. For this purpose, he passes a bistoury, flat, under the anterior surface of the phalanx, which he isolates from the flexor ten-

* Liston's forceps are generally preferred to the saw.—F. B.

dons. He does the same on the dorsal surface, and with a small saw, not thicker than a bistoury, he separates the portion of bone to be removed.

(3.) *Extraction of the First Metacarpal Bone.*

Proposed by M. Troccon in 1816, successfully performed since by Roux and Blandin. For the anatomical relations, refer to amputation of the thumb. Make an incision along the radial border of the bone, passing half an inch beyond each of its two articulations; then cautiously detach the skin and extensor tendon from its dorsal surface, and the muscles from its palmar. Let an assistant hold the edges well apart, then carry the point of the bistoury on the external side of the carpal articulation; divide the tendon of the long abductor, which is attached to the metacarpal bone, and traverse the articulation; then try to luxate the bone outwards, and pass the knife along its internal surface, to completely separate it from the flesh. Lastly, destroy its articulation with the phalanx, dividing successively the internal lateral ligament, then the external, and lastly the anterior.

You can very well avoid the radial artery, the ligature of which in any case would be an easy matter. Unite the wound by first intention, maintain the flesh in contact from before backwards by means of lint or graduated compresses, and keep the thumb in its natural position. After the cure the thumb is shortened, and at first useless; but by degrees it regains almost all its natural movements. In case the first incision does not suffice, add others at its extremities. If you would only resect the shank of the bone, after the incision of the soft parts, made as we have directed, pass under the bone a chain-saw, or cut the bone near its epiphysis with the gouge and mallet.

(4.) *Extraction of other Bones of the Metacarpus.*

You may remove as easily the metacarpal bone of the index-finger, by means of an incision on its radial side, and that of the little finger by an incision on its outside; but the probable shortening of these fingers would leave a deformity, perhaps as great as that of amputation, and would doubtless injure the strength of the hand more.

The same does not hold good with regard to the metacarpal bones of the middle and ring-fingers. These fingers might be retained in position by their connection with the neighbouring fingers, and the hand preserve its normal strength. In this case, an incision should be made along the dorsal surface of these bones, at the side of the extensor tendon, which should not be injured on any account, and the disarticulation commenced at the phalangeal joint.

(5.) *Extirpation of the Bones of the Wrist.*

Sir A. Cooper successfully extracted the scaphoid, in a case of luxation of this bone, occasioned by an accident from machinery. He lays it down as a principle, that when in an analogous case one or two bones of the carpus are displaced, they may be removed; but, if the injury be more extensive, amputation is necessary.

Velpeau was obliged, in a similar case, to remove the injured bone

with the two metacarpal bones. After having cut their dorsal attachments to the neighbouring bones, he passed a spatula into the articular intervals, using it as a lever to separate the bones. In this way he got a bistoury behind, and completed the section of the palmar ligaments. The dissection of the unciform process, under which the artery and nerve pass, requires an increase of precaution lest they be injured.

(6.) *Resection of the Articulation of the Wrist.*

Proceeding of Roux.—Make two longitudinal incisions, terminating on a level with the articulation, one along the outside of the radius, the other of the ulna, as near their anterior edge as possible without injuring the vessels and nerves, and two transverse, extending backwards from the lower ends of the first to the side of the extensor tendons that partly cover the posterior surface of the articulation. Two V-shaped flaps are thus obtained; reflect them, carefully avoiding the tendons that glide in the grooves of the bone. Isolate these tendons on all sides sufficiently to allow you to pass a compress, spatula, or piece of card, between them and the bone. Begin by sawing the ulna; then let an assistant turn the hand strongly outwards, to assist the operator in separating the fragment of bone from its attachments with the radius and carpus; lastly, let him turn it inwards, and it is then easy either to saw off the end of the radius as you did the ulna, or to dislocate it first, and then cut it off. The wound is so large that the bones of the wrist may be brought to the surface, and one or more, or even two ranges may be removed as required. We may add, that you should not busy yourself with the radial flap until after the resection of the ulna.

Dubled makes only one longitudinal incision on each side of the joint, always commencing with the ulna. He causes the hand to be pulled outwards, destroys the ulnar articulation, and dislocates the bone before cutting it off; then he goes to the radius, which he excises in the same manner.

Velpeau, on the contrary, unites the longitudinal incisions by a transverse incision on the back of the wrist, so as to have a quadrilateral flap, with its base inferiorly, which he dissects back on the hand. The tendons drawn away as much as possible, he detaches the soft part from the palmar surface of the bone, passes under them a spatula, and saws the two bones at once, then turns them back, and detaches them from the wrist.

Appreciation.—These three proceedings have this point of similarity, that one may be very easily changed to the other, even during the operation. It seems rational, then, to begin with the simple incisions of Dubled, which certainly give the best result. If the operation is too difficult in this way, join the two transverse incisions of Roux to it; but it is only in a case of very great difficulty that it would be permitted to unite them by a complete transverse incision.

Bonnet, of Lyons, has recently proposed a very well-imagined plan, which may be combined with any of the others, and which renders the operation much more easy. After the resection of the wrist, we do

not expect to preserve the movements of its articulation, consequently there is no use in sparing the tendons which are specially destined for them. Thus, the tendon of the flexor carpi radialis and flexor carpi ulnaris in front, those of the extensor radialis longior and brevior and of the extensor carpi ulnaris behind, may be divided without inconvenience, which permits the knife to enter fairly into the articulation, as well on the inside as on the outside.

The extremity of the ulna has been cut off in some cases of fracture of the radius, so severe, that the ulna was dislocated through the integuments. The operation is then much facilitated by the displacement; but care must be taken to preserve to the ulna the same length that the fracture will leave to the radius, otherwise we might see the hand inclined beyond measure to the side where the bone was shortest.

(7.) *Extirpation of the Radius.*

It was successfully performed in 1825, by Butt, of Virginia.

The forearm being semi-flexed, make a longitudinal incision on the external anterior border of the radius, so as to lay it bare; dissect back the integuments that cover it a little below its middle, push back the soft parts, and pass a director, or the handle of a scalpel behind the bone, on which saw it across, or use the chain-saw. It only remains to clear the fragments from the soft parts, and separate them from their articulations, avoiding the nerves and arteries. Here especially the two terminal incisions, such as Roux advises for the wrist and Moreau for the elbow, would be of evident use.

(8.) *Resection of the Articulation of the Elbow.*

We shall but mention the proceeding of Park, who confined himself to making a longitudinal incision in the middle of the posterior surface of the arm, or, in case of need, transformed it into a crucial incision. This method is completely abandoned.

Proceeding of Moreau.—Place the patient on his belly opposite a well-lighted window, on a table three feet ten inches high, covered with a matrass, so that his arm rests on one of the edges of the table, and presents to the operator the posterior and internal part of the articulation. You may also operate on the patient sitting; but the position is not so favourable. The tourniquet should be first applied on the upper third of the arm. The arm being semi-flexed, plunge a scalpel or bistoury down to the ridge of the internal condyle, about two inches above its tuberosity, and prolong the incision longitudinally to the articulation; do the same on the other side; then unite these two wounds by a transverse section, dividing the skin and triceps brachialis, immediately above the olecranon. The result is a quadrilateral flap, which dissect up, and cause an assistant to hold back; then, with the point of the bistoury directed on the left index-finger, detach the soft parts from the anterior surface of the bone, opposite where you would carry the saw. When the way is clear, pass the handle of a scalpel under the bone, and saw upon it; turn back the fragment cut

off, and you may easily detach it from the joint, which may be opened from before backwards; then go to the bones of the forearm.

Prolong the external lateral incision along the radius as far as necessary, separate the head of this bone from the neighbouring soft parts and ulna, pass a compress under it, and cut it off, trying to preserve all or part of the attachment of the biceps; then lay bare the ulna, prolonging downwards the internal incision, and turning down the second quadrilateral flap that results. Isolate the portion to be cut off; put it aside from the soft parts with a compress or protecting guard and saw it, preserving, if possible, the attachment of the brachialis anticus. Then loosen the tourniquet, wash the wound, and tie two or three arteries that bleed; bring together the flaps by two sutures for each lateral, and two for each transverse incision, and put the limb in a state of semi-flexion. There usually remains an interval between the bones after this operation, and the patient retains several very useful motions of the forearm and hand.

Dupuytren judiciously recommends us, after the first flap is dissected, to cautiously open the sheath of the ulnar nerve behind the internal condyle, to disengage the nerve, and to have it held inwards and forwards by an assistant during the section of the humerus. But he also advises to previously remove the olecranon, which seems to us to uselessly complicate the operation.

Others have proposed to dissect back both flaps first, and even to resect the bones of the forearm without disarticulating the humerus. It is better to do as we have said, so that we may see, by the inspection of the articular surfaces, if these bones need resection, and to what extent it should be made.

(9.) *Resection of the Scapulo-humeral Articulation.*

Several proceedings have been proposed. They may be reduced to two principal methods; simple incision, and the formation of a flap.

The method with one flap includes several proceedings. Moreau makes it quadrilateral, the base inferior; Manne quadrilateral, the base superior; Sabatier triangular, the base superior, and, moreover, he excises it; Morel cuts a semilunar flap, with its base superior; Syme first makes a longitudinal incision three and a half inches long, on the middle of the deltoid, and from its inferior end a shorter one upwards and backwards towards the posterior border of the axilla, &c. All the methods of amputation at the joint may be applied here, provided only one flap is made. On all accounts the proceeding of M. Lisfranc, with a lateral posterior flap, is incontestably the best. You may find this proceeding described under *Amputation at the Shoulder-joint*.

Nothing is more simple than the operation, when the flap is formed. You cut the synovial capsule, graze the other side of the bone, carry the head outwards, and saw it off, the soft parts being guarded with compresses. All the synovial capsule should be removed, as its floating loose flaps would impede the reunion. If the scapula is diseased, follow the caries with the gouge and mallet, if necessary.

It was to this method I gave the preference in former editions.

The simple incision seemed to me to render disarticulation extremely difficult, at least if more is required than extraction of the head of the bone necrosed, and already separated from the soft parts, or reduced to splinters by a gunshot wound. But Baudens has imagined a proceeding by simple incision, that escapes almost all the dreaded inconveniences.

Proceeding of Baudens.—He first makes a vertical incision just below the coracoid process, and then another transverse, under the skin, at each edge of the wound in the deltoid; and by this kind of bilateral incision very easily reaches the capsule, which he divides without obstacle.

It may be alleged against this proceeding, that the incision of the muscular fibres is really multiplied, and it seemed to me that a better result might be obtained.

New Proceeding.—I make the vertical incision more on the outside than M. Baudens, opposite the summit of the coraco-clavicular triangle, and carry it up to this summit; dividing at one sweep of the bistoury, the skin, deltoid, and capsule; the articulation is opened not only in front, but also superiorly almost to the glenoid cavity. The borders of the wound separate of themselves, and leave a free space for the motions of the knife.

I look upon this method, both on account of its simplicity and facility, as much superior to the others.

(10.) *Resection of the Clavicle.*

I. RESECTION OF THE SCAPULAR END.—Performed by Velpeau for a necrosis of the external third of the bone.—He made a crucial incision, each branch being four inches long, dissected back the flaps, divided the acromio-clavicular ligaments, and some fasciculi of the origin of the deltoid and trapezius, and, by means of a bit of wood pushed into the articulation as a lever, raised the diseased bone, and detached it from the sound parts.

He thinks one might succeed better by means of an incision parallel to the clavicle, some lines beneath it, which would end on the acromion, and another shorter, falling at right angles on this end, forming a triangular flap. You may use the ordinary or chain-saw. In any case, the operation is more dangerous the nearer we saw the bone to its middle point, and consequently to the axillary vessels.

II. RESECTION OF THE STERNAL END.—This operation was performed in England by Dr. Davie, in a case, the peculiarity of which increased the difficulties. It may be used in cases of decay or caries of this end of the bone.

A young lady was affected with so great a distortion of the vertebral column, that the left scapula was displaced inwards and forwards, and the clavicle gradually giving way to this impulse, left the cavity in the sternum, and passed backwards on the œsophagus. The compression exercised by the bone on this passage became so strong, that the act of deglutition could not be performed without great difficulty, and the patient became more emaciated every day, till her life was endangered.

Everything being arranged for the operation, Davie made on the extremity of the displaced bone, and, following the axis of the clavicle, an incision two inches long, divided the ligaments as far as the bistoury would reach, passed a bit of beaten sole leather under the bone, and divided it with a versatile saw, one inch from its articulating surface. The section finished, the bone still remained attached to the sternum by the interarticular ligament. It was necessary to tear this ligament with the handle of a knife, used as a lever between the two bones, and thus the fragment was removed. The wound healed without accident, and deglutition was re-established. The patient soon recovered her *embonpoint*, and was still living six years after the operation.

III. EXTRACTION OF THE ENTIRE BONE.—Performed with complete success by Mott, of New York, in a case of osteo-sarcoma. The tumour was the size of two fists, and extended upwards as far as the os hyoides and angle of the jaw.

The operator began by a semilunar incision, with its convexity downwards, extending from one articulation to the other under the tumour; he made another from the acromion process to the external edge of the external jugular vein, cut through the platysma and a portion of the trapezius, passed a director under the bone near the acromion, and then with a chain-saw made a first section in this spot. Being still unable to turn over the tumour, he united the end of the first with the second incision, placed two ligatures on the external jugular, and divided it between them; divided the external portion of the sterno-mastoid; was obliged to tie and divide the internal jugular, and to separate the subclavian vein and thoracic duct with the handle of a scalpel from the diseased tissues; divided the great pectoral, the costo-clavicular ligament, and the subclavian muscle; and, lastly, finished the disarticulation of the bone near the sternum. More than forty ligatures were tied. The wound was almost healed within six weeks; and, by means of an apparatus replacing the clavicle, the patient retained almost all the movements of his arm.

It seems to us that the method by three incisions, circumscribing a quadrilateral flap, would be far preferable here, even though it were necessary to remove a portion of the integuments afterwards.

(11.) *Resection of the Scapula.*

M. Janson removed a great part of this bone for a tumour occupying it. He commenced by circumscribing the tumour between two semi-elliptical incisions, preserving the integuments as much as possible; dissected back the lips of the wound, detached the tumour and bone in every direction as far as the subscapular fossa, cut the attachments of the trapezius, supra and infra-spinatus, and, finding that the infra-spinous part of the bone was healthy, he separated from it with the saw all the diseased portion, thus preserving the articulation of the arm. Another incision was necessary to lay bare the tumour, and allow of its removal. The wound was five and a half inches wide by eight long. The patient retained the motions of the arm on the glenoid cavity.

SECTION II.—RESECTION OF THE BONES OF THE LOWER LIMB.

(1.) *Resection of the anterior end of the first Metatarsal Bone.*

We do not remove the bones of the four smaller toes, nor the heads of their metatarsal bones—amputation is better for them; but when the phalanx of the great toe can be preserved, Blandin remarks, with reason, that the foot retains a much more solid support.

The operation is similar to that for amputation of this bone. Cut a flap on the inside with its base posterior, denude the bone to the point at which it is to be cut, and saw it *perpendicularly* to its axis; then detach it from the soft parts, proceeding from behind forwards, and finish by separating it from the phalanx.

A more simple wound would be obtained by a longitudinal incision, with two others perpendicular, one at each end of it.

Complete extirpation of this bone has also been proposed. Monro destroyed the bone in a case of caries; I removed it almost entirely, leaving only the articular head that supports the great toe; Barbier, of the Val-de-Grace, extracted it after a dislocation. These operations perfectly succeeded.

(2.) *Excision and Resection of the Bones of the Tarsus.*

As it is difficult to judge how far the operation should extend, we cannot lay down any precise rules. Moreau, sen^r., proceeded in the following manner in a case of extensive caries.

There was, opposite the cuboid bone, an ulcer an inch in diameter, and another between the third and fourth bone of the metatarsus, arising from an incision made some days before in consequence of an abscess; the director penetrated into the inside of the cuboides. The operator made an incision on the outside of the foot, from the posterior third of the fifth metatarsal bone, to above the anterior apophysis of the calcaneum, across the ulcer; the incision previously made for the abscess being large enough, it was only necessary to unite the two by a third, transverse, to afford a quadrilateral flap, which he reflected and caused to be held back by an assistant. The diseased bones were thus exposed. It was found necessary to remove the cuboid, the third cuneiform, the posterior extremity of the fourth metatarsal, the inside of the extremity of the fifth, and, lastly, the articular surface of the calcaneum by which it unites with the cuboid. The tendon of the peroneus longus was preserved, and remained bare in the bottom of the wound; the flap was then replaced, and reunited by two points of suture.

The patient was young, and recovered perfectly. The space left by the removal of the bones was filled up by a substance which afterwards ossified. Although at first obliged to use crutches, he was at last able to walk well, the foot having recovered its natural shape and movements.

These operations are not difficult—the bones are easily uncovered. The principal difficulty is in disengaging the diseased from the neighbouring bones. This is overcome by using the gouge and knife to

suit each other. Caries of the calcaneum is more serious. If you remove its inferior surface, the weight of the body no longer finds a support, and the patient is obliged to walk on the point of his foot until he becomes accustomed to a high artificial heel. If the attachment of the tendo Achillis is destroyed, the inconvenience is greater; but still the patient can walk, and it is better than removing the limb.

Moreau, jun^r., excised a portion of the calcaneum. He hollowed out all the inferior surface of the bone, and preserved the insertion of the tendo Achillis; the patient recovered well, though at first obliged to walk on the point of the foot.

Lastly, extirpation of the astragalus has been performed, after luxation of this bone through the integuments; here the state of the parts alone can guide the surgeon. After the operation, the foot generally becomes fixed to the leg. One case is related in which motion was preserved.

(3.) *Resection of the Tibio-tarsal Articulation.*

Proceeding of Moreau, senr.—Begin by resection of the fibula.—Make a longitudinal incision, extending from the inferior posterior part of the external malleolus to three inches above it; from the inferior end of this incision make another, transverse forwards, as far as the tendon of the peroneus brevis. The longitudinal incision should penetrate to the posterior edge of the fibula, the transverse only through the skin. Dissect back the flap, and disengage the fibula from the tendons round it; and as there is no interosseous space here, and you can get nothing behind the bone to guard the soft parts from the action of the saw, use the chisel and mallet; after which separate the external malleolus from the tibia and tarsus.

To resect the tibia, make in the same way a longitudinal incision, three inches long, down to the posterior edge of the bone, and another transverse forwards as far as the tendon of the tibialis anticus. Dissect back this flap, and isolate the bone behind and before, from the muscles and vessels near it. Pass the handle of a scalpel behind it, introduce under the soft parts the point of a narrow-bladed saw, which is then fixed on a handle, and with it divide the bone from before backwards. You have now only to separate the fragment from the tarsus; to do which turn out the foot (which also facilitates the removal of the astragalus if this bone is diseased), and bring together the wound by two points of suture, applied at the apex of each triangular flap. During the consecutive treatment, retain the foot immovable, by means of a sole fixed to two splints applied on the sides of the leg.

(4.) *Extraction of the Fibula.*

Proposed by Desault, performed since, it is said, by a patient on himself, and successfully by Seutin.

Not knowing how far the disease, which he supposed to be necrosis, extended, he made an incision three inches long on the inferior portion of the bone, including an ulcer developed there. Having laid bare the bone, he saw that the disease extended higher, and prolonged the incision gradually to the upper end of the fibula; there the bone

appeared sound. Extraction was immediately decided on; he detached, not without great trouble, the soft parts that were inserted into the asperities of the bone, and, after having put them sufficiently aside, applied the trepan, and separated the healthy head from the diseased shaft. That done, he interposed between the shaft and soft parts a narrow band, which he passed down as he dissected the soft parts away. Arrived at the bottom, he separated with a curved saw the shaft of the bone at the external malleolus, completing the separation with a gouge. A number of arteries were tied—amongst others the posterior tibial. The external popliteal nerve was divided, and a part of the tibia which was slightly diseased, was cauterized.

At the end of two months the cicatrization was completed. The patient was ordered to execute certain movements to avoid ankylosis, and four months afterwards he leant almost as firmly on that leg as on the other.

I had occasion, in 1833, to remove the upper third of the fibula, disarticulating it at its upper joint, which offers but little difficulty; but it is not easy to avoid cutting the anterior tibial nerve, which passes round its neck.

(5.) *Resection of the Tibio-Femoral Articulation.*

Four principal proceedings have been proposed.

Proceeding of Park.—He made a crucial incision, the transverse branch of which passed above the patella. Generally rejected.

Proceeding of Moreau.—He employed at the knee the same incisions as at the elbow, viz., two lateral incisions passing up to a suitable height on the thigh, united by a transverse incision below the patella; dissecting back the flap, and removing the patella. The articulation is in this way easily opened, and the femur dislocated forwards, isolated, and resected. If the tibia is diseased, prolong the lateral incisions on the leg, dissect back the flap, and nothing is easier than to isolate the tibia behind. It suffices to graze its posterior surface with a narrow knife; resect it with a saw.

Proceeding of Sanson and Bégin.—They commence by penetrating into the articulation through a transverse incision below the patella, and then pass to the lateral incision; the result is the same as by the method of Moreau.

Proceeding of Syme.—Bend the leg at a right angle on the thigh; make a transverse incision, slightly curved, with the convexity downwards, under the patella, extending as far as the lateral ligaments, and in the same cut open the joint; make another incision, with its convexity upwards, joining the first at each end, passing above the patella, and circumscribing that bone in an elliptical flap, which remove; destroy the lateral ligaments, then the posterior ligaments; detach the skin and soft parts from the femur first, then from the tibia; pass a split cloth about it, and cut it off with a saw.

This is certainly the most expeditious and simple method—it is the one Lisfranc demonstrates in his lectures.

After the operation, put the bones in contact, to obtain their consolidation; bring the parts together by suture, and put the limb in a

fracture apparatus; Moreau, sen^r., placed it on an horizontal board, suitably padded, and provided with upright pieces at the sides, also cushioned. This is an imitation of the hyponarthécic splint of Sauter.

(6.) *Resection of the Coxo-Femoral Articulation.*

Vermandois first dared to propose resection of the upper end of the femur; but the first attempt on man was made by White, who operated on a youth fourteen years of age, removing three and a half inches of the bone. The patient was still living eight years after the operation. Recently Seutin removed five and a half inches of the femur of a soldier for a splintering of the bone. He, like White, only made one incision, which extended from the crest of the ilium to three inches below the trochanter. It is true that the wound had already been made free, “débridée,” outwards. The patient died on the ninth day.

According to the results afforded by the simple incision in resection of the head of the humerus, I am readily inclined to believe that this plan would be the most suitable. If you prefer the method with flaps, you may cut a triangular flap on the outside (Rossi), or a semilunar with the convexity downwards, extending from the spine of the ilium to the sciatic tuberosity (Velpéau), or a semilunar flap with the convexity upwards, taking in the great trochanter (Sédillot), or lastly any variety of external flap proposed for the coxo-femoral disarticulation.

SECTION III.—RESECTION OF THE BONES OF THE TRUNK.

(1.) *Resection of the Bones of the Cranium.*

Cases are cited in which it was necessary to resect almost all the bony roof of the cranium: the rules are the same as in trepanning, aided by the saw.

(2.) *Resection and Complete Removal of the Superior Maxilla.*

Many surgeons have attempted more or less extensive resection of this bone; but the rules for the operation must entirely depend on the disease, as we shall see when treating of operations on the maxillary sinus. The description of the mode of operation belongs to Gensoul of Lyons.

Anatomy.—In attentively examining the face of a skeleton, we see that the superior maxillary bone is attached to the others in but three principal points. First, by its ascending process and articulations with the os unguis and ethmoid. Second, by the orbital border of the malar, as far as the spheno-maxillary fissure. Third, by the articulation of the two maxillary bones and palate bone with each other. There is a fourth point of contact behind with the pterygoid process and palate bone, which yields easily by simple depression of the maxillary bone into the interior of the mouth; in attacking these different points no large vessel is injured; the trunk of the internal maxillary artery may be easily avoided, or in any case tied after the removal of the bone: moreover, in case of unforeseen hemorrhage

during the operation, we have a resource in compression of the carotid. As for the nerves only one important trunk need be divided, the superior maxillary; but it is easy to cut it before removing the bone, and so prevent any strain.

Operation. (Gensoul.)—The patient is seated on a slightly-elevated chair, his head thrown a little backwards, and leaning on the breast of an assistant. The operator first makes a vertical incision, extending from the large angle of the eye to the upper lip, which he divides on a level with the canine tooth; from the middle of this incision, or rather almost on a level with the base of the nose, he makes a second, which he prolongs to half an inch in front of the lobe of the ear; and a third, extending from half an inch outside the external angle of the orbit to the point of termination of the second. The result is a quadrilateral flap, which is reflected back upon the forehead.

The bone being thus laid bare, begin with a chisel and mallet the section of the external orbital arch, near the suture that unites the malar with the external orbital process of the frontal bone; then cut the zygomatic process of the malar. Then attack its upper and internal attachments, apply a large chisel below the internal angle of the eye, and cut through the inferior part of the os unguis and the orbital surface of the ethmoid; the ascending process is in like manner separated from the corresponding nasal bone: then detach with a knife all the soft parts that unite the ala of the nose to the superior maxilla: extract the first incisor tooth of the side operated on, and slip a chisel between the two bones not directly from before backwards, but by the mouth, working it from side to side: lastly, to separate the articulation and adhesions to the pterygoid process, and above all to cut the superior maxillary nerve, pass a chisel flatly between the soft parts and floor of the orbit from above downwards and from before backwards, so as to cut the nerve well back and at the same time to get a good purchase on the bone to depress it into the mouth. It only now remains to divide with the curved scissors or knife all the soft parts that still hold the bone, and especially the attachments of the velum of the palate to the palate bone, so as to leave the soft portion of this velum extended between the pterygoid process and the other side of the mouth. The cavity resulting from the operation is formed on the inside by the septum nasi, outside by the cellular tissue which is found in so great abundance under the buccinator muscle; above, by the depressor oculi and the adipose tissue of the orbit; behind, you see the back of the throat above the velum of the palate. With the supermaxillary, a part of the malar of the os unguis, ethmoid, palate bones, and the inferior spongy bone is removed. The operation is not long; in one case it only occupied two minutes and a half, and is much less serious than one would imagine. Gensoul performed it eight times without losing one of his patients. It is sometimes necessary to tie one, or, at most, two small arteries.

Leave the wound open for a half-hour or an hour, and then bring the flap together by the twisted suture.

The only accident of the operation is the flow of blood into the

throat; on that account the patient is operated on sitting, and we commence by detaching the malar bone.

The flap of the integuments leaves a triple cicatrix, which is sometimes not large enough. May we not, as Velpeau has pointed out, commence the incision at the commissure of the lips, and direct it outwards, and then upwards, to the temporal fossa? At the farthest, it would only be necessary, for the better exposure of the bone, to cut through the lip vertically as far as the nasal orifice of the same side, and the cicatrices would be much less disagreeable than in the proceeding of Gensoul.

(3.) *Resection and Removal Entire of the Inferior Maxilla.*

Resection of a portion of the inferior maxilla was performed for the first time by Dupuytren, in 1812; since then others have gone much further, and Walther successfully removed the entire bone. It will be seen that the progress and condition of the diseases should greatly influence the mode of operating. We shall class them, after Lisfranc, into the five following proceedings.

I. RESECTION OF THE MIDDLE OF THE BODY OF THE BONE.—*Proceeding of Dupuytren.*—Seat the patient opposite the light, his legs stretched out on a footstool, so that he may have no purchase with his feet on the ground. An assistant standing behind him, encircles his head with both hands, and fixes it against his breast; and may, if necessary, compress the external maxillary (facial) arteries against the base of the jaw. This assistant stands with his legs apart, so that his position may be firmer. Place yourself in front, and at the right hand side of the patient; seize with the left hand the right portion of the lower lip, whilst an assistant holds the left portion, to extend it and draw it away from the upper lip. With a scalpel divide from above downwards, on the median line, the entire thickness of this lip; first to the base of the jaw, then, after feeling for the projection of the os-hyoides, down to it. The incision should only divide the skin and cellular tissue. From this, results two flaps, which dissect back on each side, to the limits of the disease, grazing the bone to avoid the labial arteries; turn out these flaps and give them to assistants; incise the periosteum on the bone at the spot where the saw is to be applied; and after well fixing how far the resection ought to be carried, draw the corresponding tooth on each side, to facilitate the action of the saw. Then go behind the patient (in this position the section of the bone with the saw is more easy, whilst if you stand in front the end of the saw enters the mouth and bruises the roof of the palate, which increases the difficulty of the operation), and with a fine or cock's-comb saw, divide the bone. Shield the nose and upper lip with a plate of lead, a bit of card-board, or a thick compress. The diseased portion of bone being separated, go in front again, grasp it in the left hand, plunge a straight bistoury from below upwards, behind the bone, and detach the muscles from it, grazing the bone from left to right, whilst an assistant holds away the tongue with a spatula. The operation finished, tie the arteries, bring the bones and flaps of skin together, uniting the latter by suture;

leaving a sufficient space at the inferior angle, to place there a little mèche of lint; and favour, if necessary, the escape of the pus.

When the portion of bone resected is so extensive as to oblige us to cut away a part of the integument, the portion to be removed should be circumscribed by a V shaped incision, so as always to bring the edges of the wound together, on the median line.

If the longitudinal incision does not suffice on account of the extent of the disease, make it crucial by drawing another along the base of the bone. When you remove only a small portion of bone you may saw perpendicularly; but when the piece to be removed is large, in order to bring the fragments better together, it is well for the section to be more or less oblique, according to the thickness. In this case begin to trace the groove for the saw, by four or five small perpendicular strokes; and afterwards, incline it so as to have the required obliquity; in all cases, a firm support may be obtained by applying the inferior against the superior maxilla, at least in the beginning of the section.

The submental, labial, and lingual arteries, generally bleed but little; compress them or tie them as you proceed; sometimes increased by the disease, then division causes an abundant hemorrhage. In this case, use the actual cautery, which should act on the bone; if the dental artery bleeds, plug it with a bit of soft wax.

One of the most serious accidents that can happen is retraction of the tongue backwards, after the division of its attachments to the maxillary bone; it then becomes reversed into the pharynx, depresses the epiglottis on the larynx, and causes suffocation. We saw one case of this kind in which the tongue had to be held forwards by a hook. Lallemand, to save one of his patients, was even obliged to perform the operation of laryngotomy. Whence the following proceeding:—

Proceeding of Delpech.—Before sawing the bone, he plunges a bistoury behind it, and passes through the incision a guard of wood which defends the soft parts; another protects the tongue and upper lip. The bone divided, he causes the tongue, at its point, to be seized by an assistant in a double-hooked forceps, and then divides its attachment. In making the suture, he takes care to pass a thread across the frænum, or even across the superior hyoid muscles; this thread embraces also the cutaneous flaps, if an interrupted suture is preferred, or is attached to one of the pins of the twisted suture. In one case Delpech transfixed the point of the tongue with a gold wire, which he made fast to the neighbouring teeth; by degrees the wire cut the portion of the tongue embraced by it, but the adhesions had already sufficed.

Lastly, to Delpech is also due the important precept, to respect one of the tables of the bone when it is healthy, and to confine the resection to the other table, using the file, rasp, gouge, or saw, as required. The osseous table preserved, be it ever so thin, offers a fixed point to the flesh, and preserves, to the lower jaw, all possible extent. Roux de Saint Maximin has also shown the advantage of only removing one-half the depth of the bone, when the other is healthy; the

changes these indications must cause in the operative manipulations may be easily conceived.

Appreciation.—Retraction of the tongue being probable, though not constant, it would be reasonable always to follow the proceeding of Delpech in this respect. As to the incision behind the bone previous to its section, Lisfranc correctly remarks that the contiguous parts are usually so implicated that it is no matter if they are touched by the saw, since they must be removed; and, moreover, by sawing cautiously there is little risk of tearing them. We may add, that tearing these tissues is less to be feared than is supposed, and that rupture of the inferior dental nerve even, which is unavoidable, causes no accidents. In this respect, the proceeding of Dupuytren seems more simple and preferable.

Another proceeding, that nothing can justify, consists in completely dividing the attachments of the tongue before sawing the bone. Generally the twisted suture is preferred; but the interrupted succeeded very well with Delpech; the two ends of the bone might also doubtless be fixed together by means of a gold wire, fastening the corresponding teeth, but generally it is not necessary.

The essential points are, to remove all the diseased portion, and preserve all the healthy bone; but some have tried to accomplish the resection with less injury to the soft parts.

Thus Gensoul finds fault with the ordinary method, because the cicatrix is in the median line; and when the bones no longer support the skin of the chin, a line of hard fibrous inodular tissue results, extending directly from the lip to the os-hyoides, which tends to retract and draw down the lip and flatten the newly formed chin. Consequently Gensoul places his incision so that the cicatrix may be on one side of the chin, leaving the latter free from consecutive retraction.

I do not know what may be the real value of this precaution, which, however, we may use without inconvenience; but with the method of Gensoul there remains also a very disagreeable cicatrix on the lip at the bottom of the face. Roux tried to avoid, at least in part, this deformity; and in a case which did not allow of doing more (the disease extending from the right incisors to near the last left molar), he succeeded in leaving the edge of the lip untouched, by means of a curved incision, which, starting from the depression under the chin, descended towards the hyoid region to again ascend below the left molar eminence, and circumscribed a flap which was dissected upwards. Velpeau cites this method as one that may be applied to lesions of the centre of the bone; but in trying it on the dead subject it will be very soon seen, that to expose the disease completely, and to apply the saw conveniently, the two ends of the incision must mount so high on the face that the deformity is replaced by another quite as disagreeable.

I have tried on the subject a method which is free from all these objections. It consists in detaching the lower lip from above downwards, incising at the bottom of the groove between the bone and gums, and grazing the bone as far as the chin and some lines below it, to the extent of the lip itself. This dissection made, turn down

the lip under the chin, where it is retained by the projection of the chin itself, you have the bare bone exposed and can then proceed to its section, either with the ordinary saw, or with what seems to me more convenient, the chain-saw passed behind the bone; then bring back the flap to its place; there is no need of any apparatus to retain it *in situ*, and the deformity is better masked than by any other known proceeding. It may be conceived that the same may be done if you wish to remove only the anterior surface or inferior edge of the bone. If the pus accumulate behind the flap, at worst you have only to make a small incision below the chin to give it issue; but the results obtained by the proceeding of chéiloplasty of M. Roux of Brignolles, permit us to presume that frequently there would be no need of having recourse to this incision.

When resection affects a certain extent of the body of the maxilla, the approximation of the two lateral portions sometimes excessively contracts the floor of the mouth, and pushes the tongue backwards, threatening asphyxia, which is only avoided by fixing the tongue to the external parts by a point of suture. M. Rigal de Gaillac, one of the most skilful of our colleagues, to whom I communicated my new method, asked whether the two portions of the bone might not be kept apart by an intermediate foreign body, as a plate, or wedge of ivory, or lead, so as to preserve to the mouth its natural shape, at all events, during the first few days after the operation; and afterwards in some more definite way, so as to permit a fibrous tissue to be developed in and fill up the void caused by the resection.* This idea is certainly very ingenious, and deserves to be put in execution. The foreign body, even though we might not obtain all possible success from it, would cause no material inconvenience.

II. RESECTION OF ALL THE HORIZONTAL PORTION. *First Proceeding, with the flap upwards.*—Make an incision along the base of the bone, reaching two lines beyond its angles, dissect a large flap upwards and turn it back on the face; saw the bone through on each side, beyond the limits of the disease, and separate from it the soft parts that are inserted into it behind, according to the principles pointed out above.

If the disease is found to extend into the rami, make an incision along the posterior edge of each, to join the first incisions.

Second Proceeding; two lateral flaps.—The horizontal incision being made, convert it into a T by a vertical incision, dividing the entire lower lip in the median line, and reflect the two flaps. This proceeding is easier than the first.

III. RESECTION OF HALF THE HORIZONTAL PORTION. *First Proceeding; one inferior flap.* (J. Cloquet.)—Make with a scalpel, or the scissors of Dubois, an horizontal incision, which starting from the labial commissure, terminates a few lines beyond the ramus of the jaw; two vertical incisions join this, the first descending from the free edge of

* Mr. Naysmith, of Edinburgh, contrived a simple and ingenious instrument to obviate this change of position; it consisted of a double silver case, to contain the upper molars and those below, which was made to fit on previous to the operation when the jaws were nearly closed. The machine was used by Mr. Liston on several of his patients, and answered the desired object.—Fergusson, p. 475.

the lip to the base of the bone, the second parallel to the first, descending behind the ramus of the bone to some lines below the angle of the jaw. Dissect this flap from above downwards, and separate the soft parts from the internal surface of the bone before dividing it with the saw, and perform this division with the finger-saw, the cock's-comb, or chain-saw.

Second Proceeding; two flaps. (V. Mott.)—Make a first incision, curved with its convexity downwards and backwards, from in front of the ear on a level with the condyle, to near the chin, under the labial commissure. Dissect the superior flap back on the face; make a second incision vertically downwards, from the upper end of the first to the angle of the jaw, and dissect the flap downwards: first saw the bone in front, then behind, as high as necessary, and remove all the diseased portion; when you go to a certain height, Mr. Mott advises dividing the inferior maxillary nerve, before using any traction on the bit of bone separated, and remember the proximity of the lingual nerve, so as to avoid wounding it.

Before performing the operation, the American surgeon thought it necessary to tie the carotid artery.

Third Proceeding; one superior external flap. (Lisfranc.)—First make a vertical incision, descending from the free edge of the lip below the chin; then an horizontal one from the first, along the base of the jaw to two lines beyond its angle. Dissect the flap from below upwards on the tumour, and reflect it on the face; saw the bone through first with the cock's-comb saw, and make the second section near the chin with a common fine saw. The tumour removed, re-apply the flap, and bring it together by suture.

This plan is more simple than the two others, does not expose us to collections of pus at the base of the flap, and moreover leaves but a slight cicatrix on the face.

Fourth Proceeding; one superior internal flap.—I proposed, if the disease extended far behind, and less in front, a semilunar incision along the ramus and base of the bone from the ear to the chin, so as to have one superior internal flap, and no cicatrix on the face. Velpeau put this proceeding in practice with complete success.

In all these dissections you must only include the cutaneous muscles with the skin. The masseter should be removed as far up as the bone. You meet the external maxillary artery; but it is easy to tie it before you divide it.

IV. RESECTION OF ONE-HALF THE MAXILLA AT THE JOINT.—Tried with more or less success. In most cases, the operators have thought it necessary to previously tie the carotid. The external maxillary and the internal, the dental, the transverse facial, masseteric, and temporal arteries must be divided, and there is a risk of touching the external carotid. Nevertheless, Lisfranc and others have accomplished the operation without ligature.

Operation.—On a horizontal incision along the base of the jaw, let fall a vertical incision that divides the lower lip, and another that reaches to the zygomatic arch, and passes behind the ramus of the bone. Dissect and raise the quadrilateral flap circumscribed by these

incisions, and commence by sawing the bone in front; then with a probe-pointed bistoury detach all the soft parts from the internal surface of this half of the bone; pass a probe-pointed concave bistoury behind the coronoid process, and cut the tendon of the temporalis from within outwards, and it only remains to detach the condyle. First divide the external ligament of the articulation; and whilst you twist the bone, to stretch in turn all the parts of the capsule, divide them with a scissors. The condyle detached and dislocated outwards, it is easy to pass a probe-pointed bistoury behind it, and cut the external pterygoid.

The operation is tedious and difficult; you should consequently tie the arteries as you proceed; and if ligature of the carotid trunk has been omitted, have the external carotid held out of the way by the fingers of an assistant.

Moreover, after this amputation, as after the preceding, the deviation of the remaining half of the bone towards the other side is almost inevitable.

V. REMOVAL OF THE ENTIRE BONE.—Tried once by Walther of Bonn, with complete success.

Operation.—On a horizontal incision along the base of the jaw, let fall a perpendicular incision from each zygomatic arch, dissect and throw up on the face the immense flap that results, and continue the operation on one side first, then on the other, following the course we have just described. It is evident that you would have much more facility if you first sawed the bone in its middle portion, which would reduce the operation to two amputations at the joint. There would be no need of incising the flap in the median line.

(4.) *Resection of the Ribs.*

This operation was performed by Aymer de Grenoble in the seventeenth century, and repeated in our time by Richerand.

Lay bare the diseased portions of bone, either by a straight, curved, or crucial incision, or by a quadrilateral flap; divide the intercostal muscles above and below the rib, either from without inwards or from within outwards, on a director passed under them; then detach the pleura from the rib with the handle of a scalpel, and saw through the bone with a cock's-comb or chain-saw.

Ordinarily the pleura is thickened underneath, and moreover frequently adherent to the pulmonary layer, so that the admission of air is little to be feared; but sometimes it is almost in a healthy state, or even its thickening is of such a nature that its excision becomes necessary. For this purpose use a scissors curved on their edges. The air, which immediately enters the cavity of the thorax, causes symptoms of imminent suffocation: to stop them, instantly put down the flap, or cover the wound with a thick compress spread with dressing, observing, in addition, the rules laid down on this subject for the operation for empyema.

Richerand also pointed out, as much to be feared, a dreadful hemorrhage from the intercostal artery, at the moment when it is divided.

This artery in front of the posterior third of the rib is of very small calibre, and this fear is almost without foundation.

(5.) *Resection of the Sternum.*

Galien speaks of having removed a great portion of the sternum. Many operations of the same kind have been successfully tried by modern surgeons. They generally use the trepan and circular knife. If these do not suffice, the cock's-comb saw and gouge, or a chain-saw, to divide the costal cartilages, easily finish the operation.

(6.) *Resection of the Spinous Processes of the Vertebrae.*

This operation was performed in 1829 by Dr. Alban Smith, of Kentucky. In consequence of a fall from his horse, a young man had the spinous process of one of the lumbar vertebrae displaced to the right about one-fourth of an inch from its natural position. Dislocation was supposed to have been caused. The patient survived; but two years afterwards, being affected with paralysis of the lower limbs, and being willing to suffer anything to be cured, Dr. Dudley made an incision down to the bone, and concluded, from the examination of the parts, that there had been fracture of one of the lamellæ of the vertebra which since had compressed the spinal marrow. Smith then decided to operate.

An incision from four to five inches was made along the spinous projections of the vertebrae, and at each end of the first another, transverse, three inches long, dividing all the soft parts down to the bone; the muscles were detached from within outwards in the two vertebral grooves as far as the transverse processes, and a deformed callus was exposed, as Dr. Dudley had diagnosed. Four vertebrae had been fractured. Hey's saw was used to make a section of the lamellæ on each side, near the base of the transverse processes, so that the spinous processes were removed; then the flaps were put together. The patient some time afterwards seemed in a fair way to recovery. The paralysis had diminished.

(7.) *Resection of the Bones of the Pelvis.*

Portions of the crest of the ilium have been removed in cases of caries and osteo-sarcoma, portions of the ascending ramus of the ischium, and the entire coccyx; but here you can only be guided by the extent of the disease, and must follow the general rules laid down for the treatment of caries.

CHAPTER XI.

OF AMPUTATION.

AMPUTATIONS are divided into two great classes, according as they affect the continuity of the bones of limbs or their contiguity.*

FIRST DIVISION.—OF AMPUTATIONS IN THE CONTINUITY.

SECTION I.—GENERAL METHODS AND PROCEEDINGS.

There are four general methods distinguished by the form of the incisions in the soft parts, viz., the circular, that with one flap, that with two flaps, and the oblique or oval: our especial objects are to retain a sufficient portion of soft parts to well cover the bone and prevent its projecting; to effect as speedy and firm a cicatrization as possible; and finally, so well to cover the stump that it may not be liable to excoriate on the least friction. These objects are not easily accomplished; the bone, when divided, does not shorten, but the skin at once undergoes a strong retraction, the muscles a still stronger; and, moreover, this retraction is so increased by the nervous convulsions of the stump, or violent inflammation, or prolonged suppuration, that in many cases, although the greatest possible extent of skin and muscle has been preserved, projection of the bone occurs; whilst in others, although the bone has been divided almost on a level with the soft parts, the stump escaping these accidents is covered with a good cicatrix. It results thence, first, that the choice of methods is not sufficient to assure the success of the amputation; and secondly, that the consecutive treatment has an immense influence.

There naturally follows another discussion, the object of which is to decide whether the wound should be united by first intention, or be left to suppurate; or whether, taking a middle course, and leaving it to suppurate a few days, we should reunite it by a kind of second intention. It may be said, as a general rule, that to prevent the skin from retracting, immediate union is preferable to the other methods; but when it fails it is to be feared lest the retention of pus may favour purulent reabsorption: this question is not yet settled.

Lastly, more recently it has been asked, if the preservation of muscles in the flap does not favour inflammation and suppuration without equivalent benefit, and if a reunion more speedy and less subject to these accidents would not be obtained by using only the skin with its adipose tissue to cover the stump. The subject deserves careful examination; but we may at once establish, as a rule for all cases, that the skin being the external envelop, and, consequently, having to cover a greater space than the deep layer, more of it than

* More simply according as the limb is removed, by dividing the bone in its length (continuity); or by disarticulating it (contiguity).—F. B.

of muscle should always be preserved. We shall now explain the several methods, the general rules, and the accidents that follow amputation.—

(1.) *Circular Method.*

Its name sufficiently indicates that we reach the bone through a circular incision of the soft parts. In the sixteenth and seventeenth centuries, the skin was drawn back as much as possible, a tight bandage was applied above and below the place for incision, to steady the soft parts, and the bone was cut off on a level with the section of the soft parts; there was only one incision for the whole limb; in the eighteenth century began the improvements.

1. *Proceeding of Louis. Double Muscular Incision.*—Louis, at first, applied the two bandages, and divided, at one stroke, the skin and muscles together down to the bone; but then he removed the upper bandage to permit the superficial muscles to retract; he even aided this retraction by means of a split bandage. Under this retractor, he divided the muscles that adhere to the bone; and lastly, sawed off the bone on a level with this second incision. This is very nearly the method described by Celsus, as Louis himself allows.

2. *Proceeding of J. L. Petit. Double Incision of the Skin and Muscles.*—Petit commenced his incision an inch lower than where he intended to saw off the bone, cutting down as far as the fascia only; then he drew up the integuments so that the muscles became uncovered for about one inch; then he cut them circularly, on a level with the skin, drew them up with a split bandage, and sawed off the bone on a level with the second incision.

3. *Proceeding of Alanson. Double Conical Incision.*—Alanson rejected all ligature of the limb, and made the first incision as Petit; but to favour the retraction of the skin, he cut, with the point of the knife, the adhesions of the integuments to the fascia to a sufficient extent to allow them easily to cover the wound. Then he divided all the muscles, obliquely, down to the bone on the side opposite himself; the blade of the knife being turned upwards, and plunged under the integuments so as to reach the bone three or four fingers' breadths higher than in the perpendicular incision of the muscles. When the point of the knife had thus reached the bone, he divided the rest of the muscles, bringing the knife round the limb, and following the edge of the integuments, which an assistant held away from the instrument; he did not act with the entire edge, but principally with the point, which he never removed from the circumference of the bone. He thus obtained a hollow conical stump, the base of which corresponded to the edge of the integuments, and the summit of the bone. Lastly, he sawed the bone where the second incision terminated.

4. *Proceeding of B. Bell. Triple Incision.*—He incised the skin, and dissected it back, like Alanson; and then divided the muscles to the bone, as Petit; but, arrived there, he detached them from the bone an inch up or more—which is easily done by insinuating the point of an amputating knife between them and the bone, and then

round the limb; at this height he sawed off the bone, constituting the third section, the level of which differed from that of the second.

Beside the advantage of obtaining a hollow cone, M. Baudens, who believed himself the author of this method, adds that the stump being cushioned by muscles, we need not fear that after cicatrization the nervous filaments will be compressed between the bone and cicatrix; a circumstance to which he attributes the pains frequently occurring in stumps on change of weather. This assertion needs proof.

5. *Proceeding of Desault. Triple Incision of the Soft Parts.*—Desault made the incision of the skin in the same way as J. L. Petit; the double incision of the muscles as Louis, and sawed off the bone on a level with the last incision.

6. *Proceeding of Portal. Section of the Muscles in Different Positions of the Limb.*—Portal thought he had discovered the cause of the retraction of the muscles, in the habit of dividing them all in the same position of the limb; we must own that if a muscle be divided when stretched, the retraction will be greater; and we leave less extent of it in the stump than if it had been relaxed at the time of the incision. The section of the skin then being made, when incising the extensor muscles, the surgeon should extend the limb; when dividing the flexors, flex the limb, the adductors, adduct the limb, &c. It is worth remarking that all writers have admitted the principle as well grounded, and yet most all have rejected the proceeding.

7. *Proceeding of Valentin.*—Setting out on the same principle as Portal, he arrived at this absurd conclusion, that each muscle ought to be divided when in its state of greatest extension. You would by this proceeding attain an entirely different end from that which the author intended.

8. *Proceeding of Hey. Oblique Incision of the Muscles.*—This is another modification of Portal's proceeding, which attains the same object in a simpler way. On the thigh, for instance, when amputation is performed in the ordinary manner, the limb is in a state of flexion on the pelvis, and the posterior muscles retract more than the anterior. Hey would then divide them (the posterior) only half an inch above the incision in the integuments, whilst he would divide the anterior three-fourths of an inch.

9. *Proceeding of Brunninghausen. Dissection of the Skin.*—Brunninghausen thinks it better to cover the bone with skin than with muscles, which after some time become reduced to nothing. Consequently he cuts the muscles perpendicularly down to the bone, and saws the latter off on a level with them; but he takes care to preserve by dissection the necessary quantity of skin. If, for instance, the circumference of the limb is nine inches, the diameter is three: an inch and a half of integuments should then be left. To facilitate this dissection, the skin may be turned back all round.

Appreciation.—Such are the principal known proceedings. It may be seen that nearly all of them are connected with some common general principles. Thus the method of Desault includes those of

Louis and Petit; Alanson and Bell have arrived at the same end by different ways. Portal and Hey have thrown out an idea which should not be lost; and Brunninghausen, whilst preserving a greater extent of skin, has only renewed the proceeding of Petit, and runs the chance of seeing the bone protrude beyond the muscles, when cut off on a level with them.

J. L. Petit has laid down as the first rule of amputations: Preserve as much of the soft parts and as little of the bone as possible. Alanson has put it into better form: "Shape the stump into a hollow cone, of which the bone is the summit." The difficulty of his method has caused it to be neglected. Might it not be more easily performed? The triple incision of Desault, the one generally adopted in France, does not place the bone exactly at the summit of the cone; for the muscular fibres, cut on a level with it, always retract a little on it. We propose, then, joining to it the incision of Bell, which would constitute a new method, by quadruple incision, viz., the skin, the superficial muscles, the deep muscles, and lastly, the bone, after having cleared it to a proper height. Nothing would be wanting to this mode of operating, if the incision of the muscles was directed obliquely after the proceeding of Hey.

After these important differences in the proceedings, there is scarcely any in the operative manipulation. For instance, Desault divided the skin by two incisions, cutting through half the circumference in each, and the muscles in the same manner; others retain the two cuts, but comprise in the first three-fourths of the circumference of the limb. Larrey accomplishes the circuit of the limb by four incisions, united at their extremities, one on the outside, another below, a third on the inside, and a fourth above. Lastly, Lisfranc places himself with his knee on the ground, passes the knife round the limb, so that his incision commences on the inside, and, in raising himself by degrees, he completes the incision in one sweep of the knife. The second proceeding seems to us the simplest and best.

The soft parts being divided, the utility of a split bandage in keeping them back is generally allowed. The incision of the periosteum is a greater subject of discussion. Some scrape it from below upwards, others from above downwards; the greatest number carefully cut it. Lastly, Guthrie sawed off the bone without taking these precautions, after having divided the muscular fibres only, and the cure was as speedy. There may then be some advantage in imitating him.

There has also been much of argument as to how the wound should be united, setting aside the question of first or second intention. A. Paré made two points of suture, crossed at right angles; Delpech has revived in France the plan of using sutures; but he applies them in only one direction, so as to have a linear wound. Generally we use only sticking plasters, which are more simple, less painful, and easier to remove, and unite the wound in a linear direction.

But should the direction of the wound be transverse, vertical, or

oblique? These questions cannot be answered in general terms: we shall return to them in speaking of each particular amputation.

Lastly, Kirkland advises the removal of a bit of skin from each angle of the wound, to hinder the integuments from creasing.

Larrey incises these angles with the same view, to the extent of three-fourths of an inch. This may be useful when the skin is very much swollen, and its edges will not meet otherwise; but it should not be done as a general rule.

(2.) *Method with One Flap.*

Proposed first for the leg only, then applied to the other limbs. It is often the only method practicable on the field of battle, when the entire side of the limb has been carried away, or injured by a ball.

Proceeding of Verduin.—Seize with the left hand all the soft parts which are to form the flap; with the right pass a double-edged knife through the soft parts from side to side, as close to the bone as possible, and cut the flap from above downwards, and within outwards. The flap raised, divide the remainder of the integuments and muscles by a semicircular incision, separate the flesh from the bone, and saw it as usual.

Garengeot made the semicircular incision before cutting the flap; which does not offer any great advantage, and does not really constitute a different proceeding.

(3.) *Method with Two Flaps.*

Conceived almost at the same time by Vermale and Ravaton. It has but few proceedings.

1. *Proceeding of Vermale.*—With the left hand grasp the soft parts of one-half the limb, and pass a knife through their base, to cut a semicircular flap from within outwards, taking care to graze the bone as close as possible; then draw all the remaining soft parts to the other side, and, passing the knife between them and the bone, cut the second flap in the same way as the first.

2. *Proceeding of Ravaton.*—Divide the soft parts circularly down to the bone, at a suitable distance from where you intend to saw it, and let fall two lateral incisions on the circular, so as to obtain by the dissection two quadrilateral flaps, of equal breadth and sufficient length.

3. *Proceeding of Langenbeck.*—Grasp with the left hand all the flesh on one side of the limb, and with a long knife incise it obliquely from below upwards, and from without inwards to the bone, so as not to reach the bone before having formed a flap of suitable extent. The opposite flap is made in the same way; then divide the periosteum circularly, and saw off the bone.

We prefer the proceeding of Vermale as the quickest and safest.

When a limb is amputated by the method, with one or two flaps, it is generally united by first intention. We see no advantage in the practice of O'Halloran, who allows the flap to suppurate for some time before he brings it down on the wound.

(4.) *Oblique, or Oval.*

Advised up to the present time more for particular cases than as a general method ; it only differs from the circular, in that the incision of the integuments is carried higher on one side than on the other. We shall examine in their places the value of the special proceedings.

(5.) *General Rules for Amputation.*

Most of the following rules apply to all the methods, and even to amputation in the contiguity of limbs.

1. The part must be well washed and shaved, and every thing needful for the operation prepared beforehand. There should be ready, 1st. On a first tray, the knives, the bistouries, the split bandage, or retractor, the saw, the forceps, or tenaculum, and plenty of waxed ligature threads. 2d. On a second tray, suture needles armed with threads, straps of sticking plaster cut or rolled, lint, compresses, bandages and a pincushion. 3d. Cold or hot water, and several sponges to change as required. In certain cases, a tourniquet or compressor, and one or more lighted candles.

2. The patient, for amputation of the arm, is better seated on a chair ; but you may operate on him lying in a bed, or on a table, in case of need. This last position is indispensable in amputations of the lower limbs.

3. For the minor amputations, of fingers, toes, hand and foot, there is only need of one assistant, to hold apart the fingers and maintain the limb in the desired position, or hold up the skin or the flap ; the surgeon stands immediately in front of the part to be amputated, and holds it himself with his left hand.

4. In the major amputations, of the arm, forearm, thigh or leg, two assistants, at least, are required ; one above the limb, to hold it with both hands, raise the skin and flap, hold the retractor, and maintain the limb in position whilst the bone is being sawed ; the other below to grasp the diseased part, keep firm the bone, and, after its section, assist the operator in tying the ligatures ; these two assistants should be aware of the operative manipulation intended. We also need others to hold the opposite limb, steady the trunk and other limbs of the patient, wipe off the perspiration from his forehead, give him drink, &c. : they may be chosen from among non-professional attendants.

It is useful to have other intelligent assistants present ; one to hand the instruments, water, pieces of dressing, &c. ; another to hold the candle—of great importance when we cannot operate by natural light ; and lastly, another, the most skilful and important of all, to compress the artery when the tourniquet cannot be used.

5. We generally surround the part to be amputated with compresses and a bandage, so that the pus or smell that escapes may neither soil the hands of the assistant nor offend the nose of the operator.

6. The operator first places all his assistants, and assures himself

of the compression, before confiding it to the assistant, or places the tourniquet.

7. The tourniquet, or "garrot," are preferable when you operate below the thigh or arm; for these two parts they have the inconvenience of offering an obstacle to the retraction of the muscles; they should be replaced by an assistant.

8. The operator places himself sometimes inside, sometimes outside, the limb; custom has greatly ruled these positions: a more safe rule is (unless the operator be ambidexter) to place himself so that his left hand can always grasp the upper part of the limb.

9. Whether you make flaps or employ the circular method, you should calculate the diameter of the limb, and give the skin on each side at least half this diameter. This extent of flap should even be a little increased, on account of the retractability of the skin; and you should not begin the operation until after having well fixed the length to be given to the flaps, and the spot where the bone is to be sawed through.

10. After the division of the skin, when you wish to dissect it, it is more expeditious to exchange the knife for the bistoury.

If you confine yourself to retraction of the skin, as you divide its adhesions, the assistant who has this duty should hold a sufficient surface of the integuments with the flat of his fingers, and draw them upwards with a motion of pressure and elevation combined, otherwise you will not obtain the desired effect.

11. The amputated portion should be covered with a cloth, and taken out of sight of the patient.

12. It is not well for the patient to exhaust himself by struggles and crying, but it is much worse for him to suppress them. You should then invite him to give vent to his feelings freely, if you see that he is making violent efforts to contain them.

13. If in tying the vessels you are inconvenienced by a profuse hemorrhage, sweating as it were from the surface of the bone, a very simple method of stopping it is to press on the bone with a compress.

14. The operation finished, and the arteries tied, collect the ligatures into a bundle, place them in the inferior angle of the wound, and wait half an hour before you dress the stump.

15. After the dressing, the patient should be laid in his bed, so that the limb be semi-flexed, the stump elevated, and that the wound offer an exit to the pus at its lowest part. Some surgeons are even in the habit of putting a tent or a bit of linen in the inferior angle of the wound.

16. These rules, as also those for the special proceedings, cannot always be applied in military practice. The want of assistants, and the injuries of parts, force us to modify all the proceedings; thus we were once obliged to amputate a thigh with only one assistant; the "garrot" is then a precious resource.

(6.) *Of the Accidents that follow Amputations.*

We shall say nothing here of the accidents common to all great operations. Syncope, primitive and consecutive hemorrhage, hospital

gangrene, phlebitis, cystitis, &c.; but we shall notice three special circumstances, spasm, inflammation, and convexity of the stump with projection of the bone. 1. Spasms of the stump:—one of the most powerful causes of its convexity. They are combated by putting the limb in a semi-flexed position, and fixing it to the cushion and bed, by compressing the muscles with a bandage applied all the way up the limb, and administering opium and camphor in large doses.

2. Inflammation of the stump most usually comes on after union by the first intention. The dressings and even the plasters must be removed at once, and recourse had to antiphlogistic measures, and especially refrigerants. Camphor powdered and applied between two moistened rags is the best topical application we know of. When the inflammation is more advanced, it either takes the form of erysipelas with a grayish tint, quickly passing to gangrene (Larrey, in this case, employs the actual cautery with great advantage, applied with some degree of force to the inflamed points, so as to give the appearance of branches of fern, or the fibres of a laurel leaf), or else the stump is affected with phlegmonous erysipelas. We know of nothing better than deep and numerous incisions on the most inflamed parts for its cure.

3. Convexity of the stump takes place in several degrees; either the stump is in the shape of a sugar-loaf, with the cicatrix formed and the bone covered, in which case nothing must be done; or the bone projects and becomes necrosed. Several means have been recommended for preventing this projection. Pouteau, advised above all, guarding against inflammation in the stump, which, according to him, is the only cause of muscular retraction, and proscribed all compressive bandaging. Louis recommended bandaging from the upper part of the limb, compressing the muscles, and fixing in the folds of the bandage longitudinal compresses, which cross on the stump in the manner of bandages for transverse wounds, thus bringing the flesh on the bone.

M. Foullioy of Brest has pointed out a proceeding subject to less inconvenience. He applies on the skin long straps of adhesive plaster, which form a loop in front of the stump; through this loop he passes a cord reaching over the foot of the bed, and suspends by it a weight sufficient to exercise a continual traction on the soft parts, and bring them back by degrees to a level with those in front of the bone. When the projecting bone is necrosed, it has been advised to favour its separation by attacking the projected part with the nit. oxide of mercury, or other caustics (Louis); or to try resection; incising circularly the soft parts to the necessary height. To saw the bone under these circumstances with facility and security, Bertrandi has invented a little wooden fork, on which the projecting extremity is rested. Larrey rejects all these methods as useless or dangerous, and leaves to nature the care of separating the necrosed fragment. This practice is safer than the others, but is often so tedious that the patient himself asks for more speedy means. We cannot see what the caustics can do, unless they act very near the healthy parts of the bone; resection is the most expeditious. Some treat it as a slight operation, others as

more dangerous than amputation itself. It is a point of doctrine which requires more elucidation.

SECTION II.—AMPUTATIONS IN THE CONTINUITY OF THE UPPER LIMBS.

(1.) *Amputation of the Phalanges.*

Most modern surgeons advise amputation of the phalanges to be performed at the joint only. This is a very exclusive precept, which we reject, especially where there is still enough of the phalanx left to preserve its movements.

We may use the circular method or the one with two flaps. The first is preferable, and gives the best result. Incise the skin circularly; draw it back a quarter of an inch behind the incision. Use a watch-maker's saw; and unite the integuments so as to have a transverse cicatrix.

(2.) *Amputation of the Metacarpal Bones.*

You may amputate one of the bones of the metacarpus with the finger it supports alone, or the four together.

For the first case you might choose between the method by flaps, and the oval incision. Slightly modifying the proceedings, we shall describe for amputation of these bones at the joint. The bone being exposed and isolated from the flesh as far as the place where it is to be sawed, pass a compress behind it and saw it off obliquely, so that the cicatrix and stump may form as slight a projection as possible. For instance, the fifth metacarpal bone is sawed obliquely downwards and outwards; the second, obliquely downwards and inwards; the third and fourth, indifferently inwards or outwards, but so as to allow the fingers to approach each other. We have not the same inducements in amputation of the metacarpal bone of the thumb, so it should be sawed perpendicularly to its axis. In all these isolated amputations the oval method is the best, on account of its simplicity and the beauty of its results. For amputation of the four metacarpal bones together, you may choose between the method with one flap cut on the palmar surface, or a dorsal and palmar flap, or the circular. The latter seems preferable. As all the muscles here adhere to the bone, you would make only a triple incision; through the skin first, which you would turn back and dissect if necessary—through the muscles in the interosseous spaces—and, lastly, through the bones, after having detached the muscles circularly some lines above. You should saw each bone separately, perpendicularly to its axis, carefully guarding the flesh with a split bandage, or retractor.

(3.) *Amputation of the Forearm.*

The forearm is covered with muscles, most of which become tendons towards its lower part. Larrey, with the object of avoiding inflammation in the sheaths, and having a fleshy stump, teaches that it should only be amputated in its upper third; but this idea has not gained much approval, and the rule is to amputate as low as possible. Four methods have been employed here.

Circular Method. Proceeding generally adopted.—The patient is seated on a chair, his forearm fixed between pronation and supination, and kept steady by assistants. The operator, armed with a double-edged knife, places himself on the inside of the limb if he operates on the left, and outside if on the right forearm, and grasps the limb with the left hand above the place of incision. Then,

1st. He makes an incision round the limb down to the fascia. An assistant draws up the skin, the surgeon favouring its retraction by rapidly dividing the cellular bands that retain it.

2d. He incises the muscles all round the limb with a sawing motion, and not leaving the side of the limb until he is sure he has reached the bone, lest the muscles should have only given way before the instrument. The superficial muscles slightly retract after this incision.

3d. He places the knife on the dorsal surface of the ulna, the point downwards; incises the muscles not yet divided, and the periosteum, and reaches the interosseous space; divides the muscles there, and the interosseous ligament as completely as possible, passes round the radius, returns with the point of the instrument upwards into the interosseous space, and terminates this kind of figure of 8 incision on the ulna, where he begun it.

4th. He places a compress, split into three bands, on the limb; the middle band passing between the bones; and the assistant, charged with the retraction, holds it crossing the two lateral bands behind; the surgeon then applies the saw and makes a groove with it, first on the radius, then on the ulna, and then saws freely, but so that the ulna (more solidly articulated with the humerus) is not divided till last, and consequently serves to steady the radius.

Then withdraw the compress, and seek the arteries, generally four in number. They are from above downwards. 1. The *radial*, situated in front of the radius, between the supinator longus, the flexor carpi radialis, and the flexor pollicis longus; the nerve is so far off that you need not trouble yourself about it. 2. The *anterior interosseous*, situated almost on the middle of the palmar surface of the interosseous ligament; it is accompanied by a nervous filament, which it is well to avoid. 3. The *posterior interosseous*, situated behind this ligament, also almost in the median line, but beyond the middle of the arm it is divided into small branches, which do not require ligature. 4. The *ulnar* situated in front of the ulna, between the flexor carpi ulnaris and the flexors profundus and sublimis.

Unite from before backwards so as to have a transverse wound, the angles of which cover the bone.

Some make the three incisions of Desault; but most of the muscles being adherent to the bone, the double incision of the muscles is only equivalent to the single, and you run the risk of seeing the bone protruding from the stump. Many surgeons, perceiving this danger, have recommended incising the interosseous ligament some distance above, to facilitate the retraction of the muscles; a resource of doubtful utility. We adopt two very simple means to obtain a good stump. In the upper half of the forearm we make the quadruple incision, as

we have described ; in the lower half, as there is too little flesh and too much tendon, we dissect back the skin sufficiently to cover the stump amply, according to the proceeding of Brunninghausen. In this case, also, the difficulty of dividing the tendons from without inwards has caused some to pass the knife flatly between the soft parts and the bones, and cut the former transversely from within outwards, on a level with the retracted skin, by turning up its edge.

It remains for us to say why the forearm should be put in middle position. It is to allow us to divide the flesh and bone on nearly the same level. If, for example, you saw the bone during pronation, the radius would be longer than the ulna in supination, and *vice versa*. Again, it is in the middle position that the arm is to be kept during cicatrization ; and it is necessary, in order not to retard it, that the flesh present an even surface. It was through forgetting or mistaking this fact that some authors have recommended sawing the bone during perfect pronation.

METHOD BY ONE FLAP. *Proceeding of Graefe.*—Cut a semi-elliptical flap from the anterior part of the forearm, divide the soft parts on the back of the limb semicircularly, raise the flap and integuments, and isolate the bones as much as possible. Saw as usual.

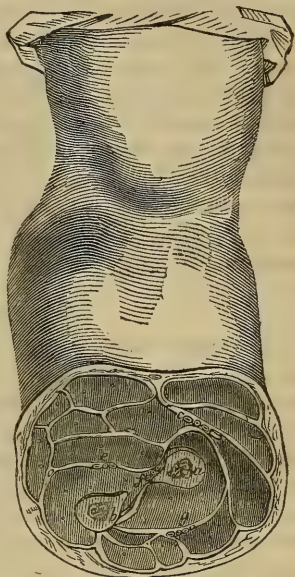
METHOD BY TWO FLAPS.—Performed by the proceeding of Vermale, only the forearm should be put in the middle position, and the palmar flap cut first. Velpeau very justly remarks that, by this proceeding, the bones are apt to project through the angles of the wound, where there is a real want of integuments. Guthrie, who advises it, but only for the lower half of the limb, admits that, in making the palmar flap, you risk wounding the radial and ulnar arteries above where they are cut across, which may give rise to various accidents.

OBLIQUE OR OVAL METHOD. *Proceeding of Baudens.*—The author describes it as follows :—

First step.—Incise ovally the cutaneous tissue, and reflect it to the extent of an inch and a half.

Second step.—Cut the muscles from within outwards, pushing in the knife, with its edge upwards, near the retracted skin, prolong its action an inch above the level of the latter, causing it to graze the bone, and bring it out again on a level with the integuments.

Fig. 8.



Section of the Forearm :—*a*, radius ; *b*, ulna ; *c*, radial vessels and nerve ; *d*, median nerve ; *e*, ulnar vessels ; *f*, anterior interosseous vessels ; *g*, posterior interosseous vessels.

Third step.—Draw aside the two fleshy flaps, cut the figure of 8, and saw the bone.

We must add, in explanation of this rather obscure description, that, from the comparison with it of other proceedings by the same author, it seems that the oval incision is made so as to leave the skin a finger's breadth longer on the side of the radius than on that of the ulna. M. Baudens proposes by this to leave a less quantity of skin at the inferior angle of the wound, and consequently to afford an exit for the matter. This object is certainly gained; but the advantage it gives is too small to make up for the loss of skin that evidently results. The rest belongs to the proceeding of Bell, and our own, and has no connection with the oval method. In fine, the circular seems to us the best as a general method. The others are only suitable in exceptional cases.

(4.) *Amputation of the Arm.*

Anatomy.—The humerus, in its four lower fifths, is surrounded by muscles, that adhere to it in its whole length. The biceps alone is an exception, and here represents the superficial muscles. Towards the axilla, the muscular mass that surrounds it, coming principally from the pectoral, teres major, and latissimus dorsi muscles, which are inserted into it almost perpendicularly, must be expected, when divided, to retract towards the chest, and leave the bone almost bare. Whence the idea of applying at this height the operation by one flap, whence also, the preference given by Larrey to disarticulation, instead of amputation performed above these muscles, especially as the supra and infra-spinatus act almost alone on the stump, and keep it in a state of permanent elevation and erection, causing a painful strain on the nerves. But this is not constant; and the stump of the shoulder when you amputate in the continuity, being more convenient and thick for supporting the braces, the doctrine of Larrey on this point has been generally rejected.

CIRCULAR METHOD. Ordinary Proceeding.—The patient being seated, or lying down, the limb removed from the trunk and raised almost at a right angle, and the surgeon standing on the outside of the limb. When you operate on the left arm, there is some advantage in putting yourself on the inside. First, the integuments are divided down to the fascia, the looseness of their attachments allowing of their being drawn back very high up; next, the muscles are divided down to the bone, and the deepest fibres cut. Care must be taken that the radial nerve, which is lodged in a groove on the posterior external surface of the bone, be completely divided. The retractor is then put on, and the bone sawed off as usual. The only artery of consequence is the brachial, which is found on the inside between the biceps and the internal portion of the triceps; the branches it gives off, and which do not require tying below a certain height, show themselves by the jet of blood. Bring the wound together from side to side, or from before backwards. The best way, perhaps, is to make the reunion oblique, so that, when the patient is lying down, one of the angles of the wound is at the lowest part.

We must add something to this proceeding. The slight retraction of the muscles renders dissection of the skin necessary, if the arm is at all thick. The second step, or incision of the superficial muscles, may very well be limited, as S. Cooper remarks, to incision of the fascia and biceps. Lastly, after incision of the deep muscles, there is great advantage in separating them from the bone for some distance, thus making a quadruple incision.

METHOD WITH ONE FLAP. *Proceeding of Sabatier.*—In amputating the arm on a level with the axilla, Sabatier advises a square flap to be made out of the deltoid, by means of two parallel lateral incisions, united by a transverse. He detached the flap, incised the rest of the thickness of the limb at its base circularly, and cut off the bone on the level of this incision.

This is an imitation of the flap of Lafaye for the scapulo-humeral disarticulation. It would be better to cut it after the method of Vermale, applied to this disarticulation by Dupuytren.

The editors of Sabatier point out also the formation of one flap only, either anterior or posterior, for any part of the limb.

METHOD BY TWO FLAPS.—You may, after the manner of Vermale, cut one flap posteriorly and another anteriorly (Klein). Langenbeck applies here his general method, already described. Velpeau seems to prefer two lateral flaps. Their direction is a matter of no consequence, and they might be equally well cut obliquely.

OVAL METHOD.—Guthrie has applied, in amputation of the bone on a level with the axilla, his oval proceeding for disarticulation at the joint, only the apex of the \vee , instead of touching the acromion, is one or two finger-breadths below.

In cases of necessity, all these methods are applicable; but, when you can preserve skin enough, the circular method is much to be preferred.

SECTION III.—AMPUTATIONS IN THE CONTINUITY OF THE LOWER LIMBS.

The phalanges of the toes are not amputated in their continuity. At farthest, you could only try it on the phalanx of the great toe. The proceeding will be the same as for the phalanges of the fingers.

(1.) *Amputation of the Five Metatarsal Bones.*

You may trace a small dorsal flap; then, plunging in the knife beneath the bones at its base, cut a large plantar flap from within outwards; or first cut the plantar flap (Lisfranc), and, after having raised it, make a circular incision, grazing inferiorly the base of the flap, and passing on the dorsum of the foot, half an inch in front of its base; or divide the integuments by the circular incision. The rest of the operation is done as for the bones of the metacarpus.

Very recently, M. Baudens has proposed combining section of the four last bones by the saw with disarticulation of the first metatarsal bone.

Lisfranc has made several objections to amputation of the metatarsus in the continuity, which tend to cause it to be rejected, and replaced

by tarso-metatarsal disarticulation. If you operate near the articulation—1. The inflammation will almost certainly extend to it. 2. The saw must act on the interosseous ligaments, which you cannot divide without affecting the articulation. We avow that the first inconvenience does not trouble us much; and Lisfranc himself has paid no great attention to it, when he advises amputating in the cartilaginous epiphyses of young subjects. The second also is not of much importance. Any one who has seen many operations performed must have remarked that the action of the saw is not so serious as he says, even on more sensible parts than ligaments.

If you operate on the middle portion of the bone, adds Lisfranc—1, the convexity of the foot hinders sawing all the bones together, and the action of the saw gives them shocks, which are likely to produce articular inflammations; 2, the bodies of the bones sawed, resting separated and without union, are submitted to the pressure of the shoes, which causes them to move, and which, joined to the small surface of their extremities, would tend to irritate and tear the cicatrix. We are sure that the shaking caused by sawing the bone is not more in this operation than in others—that it is better to saw the bones one by one than all together; that the ends of the bones become rounded off and adhere together by means of the cicatrix; and lastly, that the cicatrix, being above in the proceeding by the plantar flap, is out of the way of pressure from the bones. Moreover, some experiments and facts, collected from cases of this operation, show that there is no danger of these inconveniences. We think, then, that it deserves trial, when we have only to remove a small portion of the bones of the metatarsus.

In respect to this operation; there are few authors who have not treated as horrible the proceeding of Botal, who cut the bones with a kind of guillotine, and the more ancient proceeding, which was performed with a kind of chopper. When you operate on the middle of the long bones, without doubt these instruments are likely to splinter them; but on the epiphysis and the spongy tissues generally, we cannot deny the inferiority and barbarity of the section by saw; in our time the gouge and mallet are correctly preferred, although they do not offer the same neatness and celerity as the machine of Botal. Moreover, you may read in Verduc the history of an amputation by this proceeding, followed by a most rapid cure.

(2.) *Amputation of the first and fifth Metatarsal Bones.*

The proceedings are the same as for disarticulation of these bones, and will be described hereafter; only do not clear the bone of its flesh beyond where you intend to saw, and saw it obliquely, so as not to leave a cul-de-sac in the wound, where the pus might accumulate.

(3.) *Amputation of the Tarsus.*

In a case where the articulation of Chopart was diseased, Mayor sawed off the anterior part of the astragalus and calcaneum, and the patient recovered very well, preserving the power of walking and leaning on the heel of that side. We need not describe the operation:

it may be performed with a flap, as the disarticulation of Chopart, or by the circular method.

(4.) *Amputation of the Leg.*

Anatomy.—The leg is formed of two bones, the largest of which is covered on the inside by integuments only, and whose muscular coverings diminish from below upwards. But the necessity of sustaining the body on the bent knee, and holding the stump turned backwards after the operation, has caused the place of election to be fixed at two or three fingers' breadths below the tuberosity of the tibia: lower down, the stump would project too much backward, and be too exposed to external impressions; above, you would destroy the tendinous attachment of the flexors of the leg, known under the name of the goose's foot,* and would divide the tibia in its thickest and most spongy portion.

Nevertheless, many surgeons have tried, and not without success, to amputate the leg much lower down, and to have the weight of the body born on the stump itself, so as to preserve the movements of the knee to the limb; and Larry, in urgent cases, dared to amputate the tibia much higher than the indicated spot. So there are three principal situations where the operation may be tried.

Amputation in the place of election.

The four following methods have been advised:—

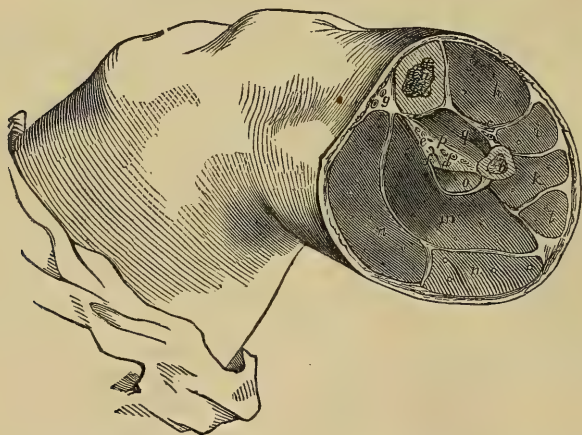
CIRCULAR METHOD. Ordinary Proceeding.—The patient should lie down with his pelvis on the edge of the bed, his legs separated, and each held by assistants. The operator stands on the inside of the limb, though there is but little inconvenience, especially for the right leg, in placing yourself on the outside, so as to always grasp with the left hand the upper part of the limb. 1. He divides the skin circularly, and has it drawn back by an assistant cutting the bands that hold it; or, what is better, he dissects it back to the required extent, and turns it over like a cuff. 2. On a level with the reflected skin, with one cut he divides the muscles to the bone. 3. He isolates the bones, carrying the knife around them in a figure of eight, and puts on the retractor or split bandage with three ends. 4. And, lastly, he saws the bones, first tracing a way for the instrument on the tibia; then completely cutting the fibula, and finishing on the tibia.

The arteries to be tied are from before backwards. 1. The anterior tibial, *c*, accompanied by the nerve, and in front of the interosseous ligament. 2. The posterior tibial, *e*. 3. The peroneal, *d*, both behind, between the soleus and deep muscular layer. 4. Sometimes branches in the gastrocnemius and the nutricional artery of the tibia. Often the anterior tibial shrinks so far back in the flesh that it cannot be found without dividing the muscles. Ribes attributes this phenomenon to the triple curvature the artery undergoes to get in front of the interosseous ligament; Gensoul to the retraction of the artery being stronger than that of the muscles which adhere to the bone; Sedillot

* See note, p. 161.

to the proceeding adopted for dividing the interosseous muscles. This part of the operation is thus performed. The edge of the knife, first placed on the external surface of the fibula with its point downwards, is brought in front, dividing the muscles on the outside of the bone down to it; then is pushed between the bones through the interosseous ligament, and divides the flesh on the outside of the tibia; then replace it on the outside of the fibula, with its point upwards, and conduct it in the same manner to the internal border of the tibia. Others begin by the posterior incision without otherwise changing the proceeding. Lisfranc uses a double-edged knife, and passes it round the limb so as to carry it with its point downwards on the anterior surface of the tibia; then on the anterior interosseous space which he traverses; then making the two edges act successively, he divides the flesh against the tibia and fibula, withdraws the knife, continues the section on the outside of the fibula, then on its posterior surface, and into the posterior interosseous space, where he acts as he did in the anterior. The figure of eight is thus described without taking off the knife. Sedillot says that in doing this, the artery and flesh are squeezed and torn by the knife, and that the inter-muscular septa are not recognizable, which renders the search for the artery long and difficult. He consequently proposes never to commence the section of the interosseous

Fig. 9.



Section of Left Leg at its upper third:—*a*, tibia; *b*, fibula; *c*, anterior tibial artery, nerve, and two veins; *d*, peroneal artery, in this subject very large; *e*, posterior tibial artery and two veins; *f*, posterior tibial nerve; *g*, internal saphena nerve and vein; *h*, tibialis anticus; *i*, extensor digitorum communis; *k*, peroneus longus; *l*, peroneus brevis; *m*, soleus; *n*, *n*, gastrocnemius; *o*, flexor pollicis longus; *p*, mass common to the flexor digitorum longus and tibialis posticus; *q*, interosseous ligament.

muscles before having determined the point where the bones are to be divided. You then make a transverse incision on the periosteum of the inside of the tibia. Then (you are supposed to be on the inside of the limb) carry the blade of the knife, the point downwards, on the outer side of the fibula at the same height, and, bringing the instrument towards yourself, cut the fibres of the long peroneus, extensor digitorum

communis, tibialis anticus, at the same time as the artery and interosseous ligament, and divide the muscles untouched behind. To enlarge the interval, you need only draw the parts a little down, and it is easy to engage the point of the instrument in the space left, and complete the section on this side, successively turning the edge of the instrument to the tibia and fibula. The first incision does not differ from that of the ordinary proceeding; all the difference exists in the second.

Whatever be the proceeding preferred for the section of the soft parts, some modification must be added in sawing the bone; for, if you saw off the bone on a level with the muscles, their retraction will leave it projecting. Velpeau advises, before applying the saw, to dissect the interosseous membrane from each bone. We much prefer the proceeding of Bell.

Many surgeons considered that this projection of the bones was caused by their shape. On this account, Roux saws the fibula higher up than the tibia; a modification of doubtful utility, but almost all in France agree in cutting off the angle of the tibia. Bécларd, after the incision of the soft parts, carried the saw obliquely on the ridge of the tibia, then withdrew the saw and applied it perpendicularly; but in this way you substitute for the anterior angle an internal one, almost, if not quite, as bad. Sanson happily corrected this inconvenience, by placing the saw obliquely, not on the ridge, but on the internal surface of the bone.

It has been advised to unite the wound so as to have a transverse cicatrix (Guthrie), antero-posterior (Hutchinson), and oblique, according to the direction of the largest diameter of the bone (Richerand); this proceeding is generally preferred in France.

METHOD WITH ONE FLAP.—It was for the leg that Verduin invented his proceeding, which has been sufficiently described. He modified it by first tracing, with lines, the point where the flap should end; then three inches above it, the spot where the anterior integuments are to be divided; and, lastly, one inch above that, the place where the flap should begin, and the bones be sawed. Which gives a flap four inches long, and leaves one inch of integument in front.

When you stand on the inside of the limb to cut a flap by puncture, carefully assure yourself of the position of the fibula, and mark with the left finger and thumb the place where the knife should enter, and come out. Without this precaution, you risk passing the knife between the bones. Several surgeons advise standing outside the limb to do it. Langenbeck altogether rejects puncture, and would have the flap made by two longitudinal incisions, and one transverse, after the manner of Ravaton.

METHOD WITH TWO FLAPS.—It reckons several proceedings, principally by puncture; but the internal surface of the tibia, opposing the passage of the knife, for each flap from the summit of the same angle, we should prefer the proceeding of Ravaton, applied on the leg by Dupuytren.

An incision two inches and a half long should be made in front along the tibia; a similar one behind; and a circular section, uniting

the end of both, forms two flaps, which should be dissected to their bases.

OBLIQUE OR OVAL METHOD.—Sabatier, having observed that, when the skin is incised whilst the limb is extended, it ascends anteriorly, and only imperfectly covers the stump in this point, proposes to flex the limb in dividing the integuments in front, and to extend it in finishing the incision behind. It is from this idea that the two following proceedings have arisen:—

Proceeding of Sedillot.—The knife, carried obliquely from before backwards, and from below upwards, on the external side of the leg, divides the integuments, then passes round the posterior portion of the limb, to be brought on its internal side from behind forwards, and from above downwards; a transverse incision completes the section of the skin in front, which thus describes an oval wound with the anterior angle rounded off.

Proceeding of Baudens.—Baudens, with the intent of leaving less integument at the inferior angle of the wound, attains the same result as Sedillot by a more simple method, which consists in cutting the integuments ovally, by carrying the anterior part of the incision one finger's breadth below the posterior.

Another reason, which has not been noticed by any author, makes us prefer the oval incision even to the circular. In fact, in the latter, the principle is, that the integuments should be long enough on every side to cover half the stump; but the posterior integuments, by pushing back the muscles they cover, reach the centre by a much shorter road than the anterior, which are forced to fold over the tibia; the object is not then attained, and can only be by giving more length to the anterior integuments.

In fine, this is the proceeding we prefer for amputation of the leg. It is also nearly that adopted by Baudens. It is divided into five steps:—

1. Oval incision of the integuments, which dissect and turn back two inches.

2. Circular division of the muscles down to the bone.

3. Separation of the muscles half an inch up, according to the proceeding of Bell, grazing the tibia, fibula, and interosseous ligament with the knife.

4. Section of the flesh and interosseous ligament, by the figure of 8, and application of the retractor.

5. Section of the bones, after the method of Sanson.

Amputation below the Place of Election.

All the methods for amputation at the place of election have been applied here. Velpeau advises dividing the integuments, so that the cicatrix may be behind rather than in the centre of the stump. This is of slight importance if the stump is properly fitted, and does not press on the boot. Lenoir thinks he has observed that the circular incision, and even that with two flaps, with dissection of the integuments, exposes the latter to gangrene; and besides that, the amputation itself, whatever be the proceeding adopted, is often complicated

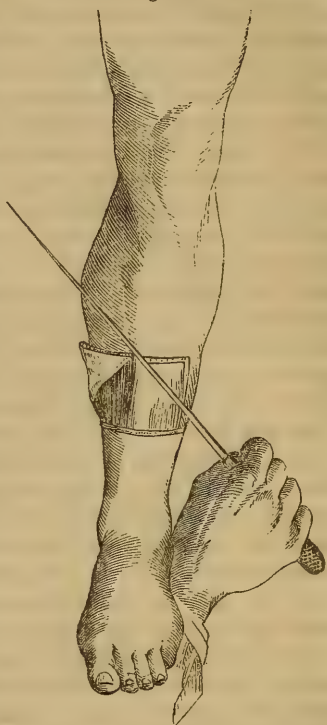
with purulent sinuses in the cellular tissue, separating the two layers of the posterior muscles of the leg. With the idea of remedying these two inconveniences, he has proposed the following proceeding:—

Proceeding of Lenoir.—The operator standing on the inside of the limb (a position which renders the simultaneous section of the two bones easier), with a middle-sized narrow interosseous knife, makes a circular incision, that should not pass deeper than the fascia, one and a half inch below the place where the bone is to be sawed. That done, he makes another vertically down to it from the point where the bone is to be sawed, along the internal surface of the tibia, near the crest of that bone. He dissects the two angular flaps formed, and turns them back, leaving them as thick as possible, and not dissecting beyond the anterior third of the limb, and consequently not dividing the cellular connections that unite the skin to the soft parts behind and on the sides. He thus obtains a kind of cuff split in front, the anterior part of which only is turned back on the sides of the tibia. This gives to the incision an oval form, which the knife should follow in the first section of the muscles. The surgeon then replaces the edge of the knife on the external border of the tibia, working it freely, and brings it to its internal border, exactly following the oblique edge of the reflection of the integuments. An assistant retracts the skin and muscles divided; the operator cuts transversely the muscles of the deep layer, penetrates as usual into the interosseous space, passes the retractor, and finishes by sawing the two bones together on the same plane.

In dressing, bring together the two lips of the vertical incision by a point of suture, and, to favor the free egress of pus, keep the wound a little open, with a bit of fine lint introduced into it.

This proceeding appears very well reasoned for the object proposed, and we willingly give it the preference. Altogether, the inferior amputation of the leg compromises life less than that at the place of election; but the great objection is the difficulty of obtaining a tight boot. That of Martin is as yet the best we know of; but yet I must mention that several patients, after having tried it, have gladly taken to the wooden leg. I have already cited the case of a young girl who used it, and found it heavier and more painful than the ordinary

Fig. 10.



Proceeding of Lenoir.—Oval amputation below the place of election.

wooden leg. She said the step was less sure; and declared that, were it not for appearance, she should prefer the latter.

Amputation above the Place of Election.

Proceeding of Larrey.—The section of the bones should not be made above the tuberosity of the tibia, for fear of depriving the ligamentum patellæ of its attachments, of opening the synovial bursa placed behind, and even of entering the articulation. Assure yourself beforehand of the exact situation of this tuberosity: it presents a triangular surface, whose inferior angle is confounded with the crest of the tibia. The ligamentum patellæ is inserted into all this surface; but it may be without fear divided almost to its base, as only a small portion of its attachments need be left.

Divide the skin as usual, preserving as much of it as possible. If the bone is to be divided very high up, having drawn back the skin, make a longitudinal incision on the fibula; dissect from both sides the muscles that are attached to it. By moving it, you recognize its articulation, which is formed of plane surfaces, easily separated; disarticulate it. The operation then resembles amputation of the thigh or arm, the tibia resting alone; divide the soft parts, and saw the bone. The saw, here, should act perpendicularly to the axis of the limb.

If the dissection of the skin has not exposed the articulation of the fibula, cut it off: the operation is here easier than at the place of election, the interosseous space, so to say, no longer existing. Another advantage is that there is only one artery to be tied, the popliteal not dividing till farther down. If the bone is diseased higher up, you may saw it obliquely upwards and backwards, preserving the attachment of the ligamentum patellæ in front.

It is essential to know that, in disarticulating the fibula, you may expose the knee-joint itself to the entrance of air. Out of forty subjects, M. Lenoir found in four a large communication existing between the synovial membranes of the two joints; and in twenty the synovial of the knee sent a diverticulum as far as the head of the fibula, which it would be very difficult to avoid wounding. We may add that the disarticulation of the fibula removes the insertion of the external ligament of the femoro-tibial articulation, and of the biceps; but, notwithstanding these inconveniences, the advantages of this proceeding over disarticulation at the knee are so important, that it seems to me in all cases preferable.*

* When muscular plethoric subjects meet with sudden and severe accidents which demand immediate amputation, the large quantity of muscle which is necessarily left in the flap is liable to suppurate, to retard very much the patient's recovery, and sometimes to produce serious consequences. In such cases, I have performed the following operation below the knee. Supposing the left leg to be injured—with a common amputating knife an anterior semilunar incision is made through the skin, commencing from the inner side of the tibia, about four fingers' breadth below its superior extremity, and passing over its anterior aspect. A similar semilunar incision is made at the posterior part of the leg, its extremities joining the horns of the previous incision. The integument is then reflected upwards to a sufficient extent to cover the bones, and the operation finished after the manner of the circular amputation. In fact, this operation differs from the circular only in the form of the incision through the integuments.—Liston's Op. Sur. p. 378.

(5.) *Amputation of the Thigh.*

Anatomy.—The femur is covered on all sides by thick muscles, the mass of which decreases from above downwards, so as to give a conical form to the thigh. These muscles form two layers. The superficial comprises the rectus, the sartorius, the gracilis, the semitendinosus and membranousus, and the long portion of the biceps (see Fig. 11); so that all that has been said generally on the different incisions of muscles perfectly applies to amputation of the thigh, which all authors have had in view in forming the general rules.

As the superficial muscles all spring from the pelvis to go to the leg, the lower you cut them the more they retract, and *vice versâ*. Whence it results that, no matter where you amputate, you must leave nearly the same extent of soft parts to cover the stump; above, on account of the size of the wound—below, to make up for the increased muscular retraction. Moreover, the posterior part of the femur being almost uncovered by deep muscles, retraction is stronger there than on the other sides; the more so as the slightly flexed position of the thigh, by stretching the posterior muscles, favours still more their retraction, and leaves them, when cut, less real length than the others. The same thing takes place, but in a less degree, on the inside compared with the outside, the latter only offering muscles adherent to the bone, and the muscles on the inside being also extended by abduction. This explains why, after circular amputation, the cicatrix is almost constantly behind and inside, and puts us in the way of a more rational proceeding.

CIRCULAR METHOD. *Ordinary Proceeding.*—The patient is laid on a bed or table, with the thigh uncovered, and sufficiently separated from the other, and slightly flexed on the pelvis. The surgeon, standing on the outside, circularly divides the skin as low down as possible, has it drawn back by an assistant, and divides the superficial muscles alone, or with them the deep layers also down to the bone. These last being retracted, he divides completely the deep layer, applies the retractor, and saws off the bone.

There are some points to be noticed here. It is almost impossible, at least unless amputation be performed very low down, for the surgeon to stand conveniently on the inside of the limb when operating on the left side. The English always stand on the right side, so as to operate over the other thigh. This position is not more handy than the other; you must choose between them.

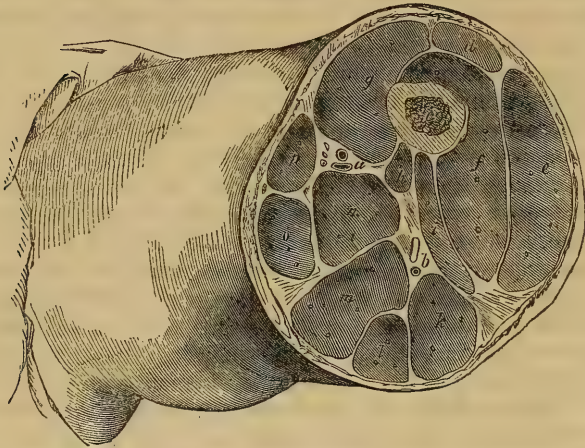
If you retract the skin dividing the cellular bridles that hold it, you must remember that in front of the border of the ham it adheres more strongly to the fascia than anywhere else. But it often happens that we cannot thus entirely cover the large surface of the stump; and Velpeau advises, with good reason, to dissect the integuments to the extent of two inches, turning them back. After this dissection and the two muscular incisions, we in addition detach the muscles from the bone, after the manner of Bell, so that the bone is sawed about three and a half inches above the place of the cutaneous incision.

You should remember that the femur has a crest or ridge on its posterior surface, which easily splinters under the saw, and requires some management.

Sometimes, after the complete separation of the limb, the sciatic nerve projects beneath the retracted muscles. When this projection is such as to render the dressing painful, it should be immediately cut off higher.

You must tie, first, *the femoral artery* (Fig. 11, *a*), placed on the

Fig. 11.



Horizontal section of the thigh a little below its middle point: *a*, femoral artery and vein, two small nerves that accompany it and the anastomotica magna artery; *b*, sciatic nerve and an artery that accompanies it; *c*, femur; *d*, rectus; *e*, vastus externus; *f*, crureus; *g*, vastus internus; *h*, adductor medius; *i*, femoral portion of the biceps; *k*, sciatic portion of the biceps; *l*, semi-tendinosus; *m*, semi-membranosus; *n*, adductor magnus; *o*, gracilis; *p*, sartorius.

inside under the sartorius, and with which you must not comprise the saphena nerve (situated on its external and anterior side); second, the *superficial* and *deep muscular* branches, &c., whose number and position vary according to the height at which you amputate, and which show themselves by the jet of blood.

As to the manner of uniting the wound, some make the union transverse, others from before backwards. The inconveniences are equal in both ways. With a transverse wound you have a cul-de-sac below, where the pus remains; with an antero-posterior, there is one angle of the wound always leaning on the cushion; and in all cases the transverse section of the bone leaves an acute angle in front that irritates the soft parts. Lately, M. Lesauvage has proposed to remove this angle, by giving an oblique direction backwards to the section of the bone. It is a proceeding that may be useful, on condition that the acute angle formed is also cut off. Perhaps, after all, the oblique reunion of the wound is the best.

METHOD WITH ONE FLAP.—M. Foulloiy has performed this amputation successfully, cutting an anterior flap. We have nothing to add here to the general proceeding.

METHOD WITH TWO FLAPS.—Vermale, Ravaton, and Langenbeck have described their plans as only applicable to amputation of the thigh. We refer you to the general descriptions.

OBLIQUE OR OVAL METHOD.—This method has not, that we know of, been either practiced or advised. It is from consideration of the anatomical facts exposed above that we propose it, to replace the circular.

The muscles and even the integuments of the internal and posterior part of the thigh being more liable to retraction than those of the other side, it is necessary, in order to have an even surface, to cut them a little lower. The incision must then have an oval shape, or rather the form of an ellipsis, one extremity of which corresponds to the external anterior part of the thigh, and the other descending one inch lower down, at the posterior internal part. The double section of the muscles must be in the same direction; then detach the muscles from the bone, and finish as in the circular method. After the retraction, you obtain a really even and circular surface, which may be brought together obliquely, so as to allow the pus to flow by the external posterior angle of the wound. You would of course leave the skin as long anteriorly as in the ordinary method; for it is not a diminution of substance we would produce on this side, but an augmentation on the other.

SECOND DIVISION.—AMPUTATION IN THE CONTIGUITY OR AT THE JOINT.

SECTION I.—OF AMPUTATIONS IN THE CONTIGUITY GENERALLY.

Employed by the ancients, and afterwards by the surgeons of the sixteenth century: they then were forgotten, until the works of Morand, Ledran, Heister, Brasdor, Hoin in the eighteenth, and of Larrey, Dupuytren, Lisfranc, and Velpeau in the nineteenth century, have again given them popularity.

We employ, according to circumstances, the circular method, the oval, or one or two flaps. One knife is sufficient, but various shapes are used. Lisfranc's are narrow, to turn more easily in the joint; and have a thick back, to assure their solidity. The apparatus for ligature and dressing are the same as for the other amputations.

The operator has here three special objects in view: 1. To well recognize the articulation before commencing. 2. The flesh being divided, to traverse the articulation without hesitation, destroying all its means of attachment. 3. To preserve flesh and integument enough. Whence the following rules:—

(1.) *To recognize the Articulation.*

1. The surgeon should have the disposition of the articulation so fixed in his mind, that he could, without having it under his eyes, trace it out exactly. In this way, recognizing one part of the articulation, he is sure of the others, neither the blood nor the soft parts

causing the knife to deviate. He must also know the direction of the ligaments, to attack them more surely; their length, to cut them between their attachments; their breadth, to divide them completely.

2. The surest guides in finding the joints are the osseous projections. It is with them you must first occupy yourself. To find them, you may place the limb in a position that causes them to project; seek them on the side where they are most prominent; put aside by careful pressure the soft parts, fat, or œdema that mask their projections; and, lastly, seek them starting from a known point: for example, passing the finger along the shank of a long bone till you reach its extremity.

3. The second indication consists in the folds of the skin, sometimes placed immediately above the joint, sometimes some way from it.

4. You may, as a third resource, cause to be prominent to the sight and touch the tendons which are inserted near the joint. To effect this, cause the muscles to contract; this is usually sufficient: or you may render their projection greater by opposing the movement of the limb which their contraction tends to execute.

5. If all these trials fail, you may assist yourself by the neighbouring tuberosities, whether or not they be in the same line, provided their distance and connections are well determined beforehand. It is objected that the relations, and especially the distance, vary in different subjects; consequently, they can only give us a tolerably close indication: but certainly there is never more than some lines difference; and it is better to have such approximation than none at all.

6. If these means do not suffice, seize the limb with the right hand, and seek the joint with the left, moving the limb slightly, and thus try to mark out the two diameters of the joint, or, in other terms, the point of entrance and exit of the knife.

7. Lastly, supposing that all these indications do not afford a certain result, incise the skin in the most suitable direction, and, after having raised it, assure yourself by the touch of the articular line. If the touch does not point it out, place the knife in the angle of the wound nearest yourself, its heel perpendicular to the horizon, and the edge perpendicular to the bone, and thus move it along the bone with a sawing sidelong movement, without taking it off, and the pressure will cause the knife to enter the joint when it reaches it.

(2.) *To traverse the Articulation.*

1. The articulation recognized, or, at all events, presumed to be so, as we have directed, the index finger and thumb should rest applied on the two extremities of the articular diameter until the knife replaces them. If this search has been made with the right hand, substitute the left hand for it before seizing the knife. In this way you mark the point of entrance and exit of the knife.

2. If you attack the joint by its dorsal surface, semiflex the limb, to extend the parts and enlarge the articular line. Without this precaution, you often fall on the neighbouring joint, as happens on the foot and hand.

3. The knife should not generally be carried into the joint without having first cut its principal means of connection, which should be divided from without inwards.

4. In joints with several projections and interlockings, commence by the internal or external side. As the knife opens one part, do not push it in there, but go on dividing and opening farther. In this way, the ligaments are not put out of the reach of the knife, or shielded by bony projections.

5. An important fact. An articulation, that offers to the anatomist a surface equal to one inch, presents to the operator at least four. So long as the ligaments are divided between their attachments, it is of slight importance whether during their division the knife fall on the articular line or at the side of it.

6. The dorsal and lateral ligaments being cut, we can generally engage all the blade of the knife between the articular surfaces; but if there are interosseous ligaments, they must be first divided. Carry the point of the knife directly on them: as they are divided, the joint opens.

7. To destroy these ligaments, you must know the interstices between the bones through which they may best be attacked. In general, on the hand and foot, the bones, very compact on their dorsal surface, leave between them on their palmar and plantar surfaces intervals which lodge these ligaments. Carry the knife under these intervals, inclining the handle towards yourself, and making it form an angle of 45° anteriorly; then raise it up to a right angle. The ligaments divided by this movement allow the articulation to be opened sufficiently for the knife to enter it.

8. It is useless to luxate: it strains the parts very painfully; and if you separate the parts very much on one side, you apply those of the other together. If in cases of difficulty you have recourse to this means, luxate downwards as far as half the dorso-palmar diameter, and then *vice versâ*. But it is better to separate the parts by slight traction parallel to the axis of the stump: this ordinarily suffices. The heel and point of the knife should always move in the same line. If, in bringing the knife out of the joint, you dread jaggling the integuments, push them gently aside with your left forefinger and thumb.

(3.) *To preserve sufficient Flap.*

1. The proceedings vary according to the method, and often even in each method.

2. In the circular, you can generally count only on the skin to cover the surface of the wound. Make the incision at a sufficient distance from the joint, and dissect back the skin as a cuff. If there are muscles under it, you may cut them obliquely on the plan of Alanson, or divide them perpendicularly on a level with the joint.

3. The oval method is ordinarily performed by tracing on the dorsal surface a \vee incision reversed, the ends of which are joined by a semicircular incision round the palmar surface. When there are any large vessels, leave them in the portion to be divided last, as in

the method by flaps, so as to be able to compress the artery before dividing it beyond the part compressed.

4. In most of the oval proceedings, the second incision is made to join the first at its point of commencement. A loss of substance is the consequence; or, if the V terminates on a level with the articulation, there is considerable difficulty in getting the knife to act in disarticulating. I lay down here as a general rule, *expose the joint to be destroyed by a longitudinal incision passing half an inch, at least, above, and one inch below it.* The two branches of the V, which fall on the inferior part of this incision, leave, as it were, two small flaps at the upper part, which do not hinder immediate and linear union, and which perfectly cover the osseous prominences left by the disarticulation.

5. The methods by one or two flaps are executed in two ways. Sometimes the flaps are made first, before touching the joint; but most usually a simple incision is made first, or the least important flap, and the second is not begun till after the disarticulation.

6. The knife having traversed all the joint, when the bones are large and uneven, as in the foot and hand, the instrument must be withdrawn, and its point placed horizontally in the extremity of the joint next the hand operating, and its way cut by pressing from right to left. It is thus placed under the entire breadth of the bones to be removed.

7. To avoid terminating the flap by a point, the knife must be held horizontally close to the bones, and kept so to the required extent, cutting freely. When enough has been detached, turn the edge directly outwards, and cut it cleanly off.

8. It is well, before you terminate your flap, to apply it to the part to be covered, to see if it is long enough.

9. If there remain any tendons beyond the bleeding edge, cut them off with a scissors.

10. If you fear too much retraction of the skin, do not divide it until the muscles have retracted.

11. You may cut your flap from engorged tissues, so long as the engorgement is not malignant. Suppurative inflammation, well directed, brings them back to a normal condition.

12. Lastly, you may even operate when there is not enough skin to make a flap. A cicatrix will be formed on the articular surfaces.

SECTION II.—AMPUTATION AT THE JOINT IN THE UPPER LIMBS.

(1.) *Amputation of the two last Phalanges of the Fingers.*

Anatomy.—The joints of these phalanges are held together loosely enough by the anterior ligament, and behind by the extensor tendon, but much more tightly by the lateral ligaments; the latter then must be destroyed if we wish to open the joint widely. The direction of the articular surfaces is almost transverse; it is on a level with the cutaneous fold on the palmar surface of the joint of the first and

second, and half a line below this fold in the articulation of the second and third, phalanges.

CIRCULAR METHOD.—This is the oldest proceeding. The finger being extended, make a circular incision three or four lines below the joint (recognized by the position of the palmar cutaneous folds), raise the skin, and dissect it back; then enter the joint before or behind, as in the following methods :—

METHODS BY FLAP.—Garengéot made two flaps of equal length, one dorsal, the other palmar, by dividing the circular incision by two longitudinal incisions; others make these two flaps semilunar. Ledran made lateral flaps, &c. The method by one flap applied on these joints, by Lisfranc, appears to us to combine more facility with equal advantages.

First Proceeding of Lisfranc.—The joint is opened on its dorsal surface. If you would remove the last phalanx, pronate the hand; an assistant holds away the sound fingers, and at the same time turns back the skin of the deceased finger, and retains it in position. The operator seizes the phalanx with the thumb and index finger of the left hand placed across it, on its palmar and dorsal surfaces, and bends it to an angle of 45° . There are three ways of recognizing the line of the joint. 1. There is on its dorsal surface a well-marked fold in the skin; the joint is half a line below it. 2. If you cannot find this, assure yourself of the dorsal projection formed by flexion, and cut half a line beyond it. 3. Seek the termination of the palmar fold; you will find the joint also half a line below it.

Then take a straight bistoury in the third position, and, applying its heel perpendicularly on the recognized extremity of the articular interline, cut from left to right a very small semicircular flap, which terminates at the other extremity. You should divide the capsular ligament in this cut: if you have not, seek it by the indications given. Then, without entering the joint, cut the lateral ligaments.

For the ligament situated on the left of the surgeon, carry the bistoury on this side perpendicularly to the axis of the last phalanx; the handle nearer the operator than the point, and the edge also slightly turned towards the operator. In this way, the incision is perfectly suited to the articular surfaces, and the ligament is divided at the first cut.

Bring back the bistoury to the other side, and attack the second lateral ligament in the same manner; only here the handle of the bistoury is turned downwards, and farther from the operator than the blade.

When the surgeon is well practiced, these three steps are comprised in one; and in the same cut, the skin, the left lateral ligament, the dorsal ligament, and the right lateral ligament are divided.

In whatever way you attain this point, after having widely opened the joint, seize the phalanx by its sides, and by degrees extend it; whilst the bistoury, entering the articulation, divides the palmar ligament, passes round the head of the phalanx, slips parallelly under it, and at the same time cuts a semicircular flap, large enough to cover all the solution of continuity.

If you would remove the two last phalanges, the proceeding is the same, only the dorsal incision should start on each side on a level with the termination of the palmar fold in the skin.

In performing this proceeding, inexperienced operators are frequently misled. It has also another inconvenience in unpracticed hands, viz., the base of the flap is cut and jagged in dividing the lateral ligaments; but a little practice gives all the necessary precision in this respect.

Second Proceeding of Lisfranc.—The joint is opened on its palmar surface. Strongly supinate the hand, with all the fingers flexed but the one to be operated on, seize the phalanx by its dorsal and palmar surfaces with your left thumb and forefinger, taking care to have your own fingers parallel to the axis of the one to be operated on, or you may wound yourself. Moreover, the index finger should extend some way beyond the joint to be destroyed; the thumb, on the contrary, remains at some distance, to allow the bistoury to act freely in cutting the flap.

Things being thus arranged, take a pointed straight bistoury in the third position, with the blade turned horizontally, and the edge towards yourself; place the point of it half a line in front of the palmar fold in the skin, if you amputate the third phalanx, and at the base of this fold if the second. Push it in this way right through, grazing the anterior and lateral surface of the bone, and raising as much of the tissues as possible. For this purpose, it is recommended, when you put in the bistoury, to hold the handle not quite so much raised as the point. As it advances, again make it horizontal; and, when the point is almost through, raise the handle a little more than the blade. Push the instrument in up to its heel, and, in drawing it out, graze the anterior surface of the bone to the extent of half an inch; then turn up the edge to finish a semilunar flap, and, replacing the edge perpendicularly at the base of the flap, divide the ligament. In this proceeding, it is scarcely necessary to divide the lateral ligaments separately; generally, one cut divides them both at once, and allows the bistoury to pass through the joint. Finish by cutting the tissues on the dorsal surface without making any posterior flap.

Performed on sound tissue, this proceeding makes a flap more regular and better nourished than the first, and offers more certainty in the operative manipulation, but it preserves in the flap a considerable length of the extensor tendon, which you are advised to cut off with strong scissors; a precaution which is not sufficiently justified.

Ordinarily, there is no vessel to be tied; bring the wound together with straps of adhesive.

(2.) *Amputation of the entire Finger.*

Anatomy.—The metacarpo-phalangeal articulations are enarthroses, maintained by loose ligaments; but it should be remembered that the articulating head belongs to the metacarpal bone, and that in flexion of the finger it alone projects, the phalanx rolling on its anterior sur-

face. In the healthy condition, the joint is generally found an inch above the digital commissure.

An indication which we pointed out, and which may be employed when the soft parts are but slightly diseased, consists in extending the finger and drawing it away from the metacarpus; the articular surfaces then leave an interval between them of one line or more, and a depression, sensible to the touch and sight, points out this interval on the dorsal surface.

The method by two flaps, as well as the oval and circular, is applied to this operation.

METHOD BY TWO FLAPS. *Proceeding of Lisfranc.*—The hand being pronated, and the neighbouring fingers held away by an assistant, the operator seizes the first phalanx by its dorsal and palmar surfaces, and causes it to execute the necessary movements so that the right index may feel and recognize the joint. These preliminaries being accomplished, first flex the phalanx to an angle of 45° , extend the skin below whilst an assistant retracts it above, and carry the bistoury, in the third position, a quarter of an inch beyond the articulation on the head of the metacarpal bone. Then make a free incision, starting from the union of the two internal with the external third of the joint, if you operate on the left hand, and *vice versa* on the right, dividing as much as possible the extensor tendon, and descending with so much obliquity that it falls on the lateral surface of the finger on a level with the digital commissure; then raise the knife perpendicularly, to divide the end of the flap transversely; and when you reach the digital commissure, depress the hand, carrying the handle of the instrument towards the wrist of the patient to make the same oblique incision on the palmar surface.

Next detach this first flap from the phalanx, then move the knife towards the joint with a sawing motion on the bone until you meet with an obstacle, which is the head of the phalanx; continuing the motion, and holding the blade upright, you are certain to enter the joint; open it freely from side to side.

Lastly, slightly luxating the bone, and putting aside the untouched skin, pass the blade behind it, and cut the second flap as the first to the digital commissure.

When you perform this operation on the index or little finger, you must take care to give more extent to the outside flap. In this case, it is prudent to measure the extent it should have, bringing it to the surface of the joint before dividing it.

It is seldom you are obliged to tie the collateral arteries,—heal by the first intention, bringing the neighbouring fingers together.

When you amputate the last phalanx of the thumb, the proceeding and indications are the same as for the second phalanx of the other fingers.

After the removal of the last phalanx, the tendon of the flexor profundus remains inserted into the second, and assures flexion; but it was feared lest, when the second was removed, the flexor tendons losing their insertion, flexion should become impossible. Accordingly, Lisfranc advised making on the palmar surface of the first phalanx a

longitudinal incision down to the bone, to determinate an inflammation that shall cause the flexor tendons to adhere to the phalanx, and retarding the amputation until the cicatrix of this first operation was formed. But it has been said that there is a natural fibrous band fixing one of the flexor tendons to the first phalanx, and Lisfranc assured himself, from analogous cases, that the flexor tendons and others are always fixed, after the cure, either to the cicatrix or to the bone itself, and all the movements are preserved. Nothing then justifies these incisions, which Lisfranc himself has now renounced.

OVAL METHOD.—All being disposed as for the preceding method—

1. The operator begins a quarter of an inch above the joint an oblique incision, which he brings directly to the digital commissure; then he extends the finger, and continues his incision on the palmar surface, exactly following the crease in the skin that separates the finger from the hand; arrived at the opposite digital commissure, he flexes the finger again, and continues his incision to join its other extremity, one-sixth of an inch from the point where it commenced.

2. He draws the fingers well apart, slightly dissects the lips of the wound, opens the joint by its dorsal surface, then divides one after the other the lateral ligaments, and finishes by detaching the finger anteriorly.

Some advise performing the operation in three steps: *First*, making an oblique incision on each side, figuring a V reversed. *Second*, entering the joint from behind forwards. *Third*, finishing by dividing the skin in front, opposite the cutaneous crease, thus finishing the oval incision.

In the first step, some would have the bistoury change hands for each oblique incision. This complicates the difficulty, and they may be both very well made with the right hand.

The result of this method is a linear cicatrix, which does not at all extend on the palm of the hand. The only thing to be feared is that you may not have enough skin to cover the head of the bone; this happens when the summit of the V is begun too high up on the hand, and its branches are too far apart. It is certainly obviated by flexing the finger as much as possible, commencing the first oblique incision a little to the left of the median line, and causing the second to fall on it one-eighth or a quarter of an inch below its commencement.

The proceeding for amputating the first phalanx of the thumb is the same; but we must warn you, as well in the formation of flaps as for the oval incision, that there are two palmar creases corresponding to this phalanx, and that it is to the inferior one that our indications apply.

It is in amputation of the thumb, especially, that it is essential not to leave a cicatrix on the palmar surface, which rubbing against everything grasped in the hand would cause severe pain. I witnessed a case of this kind, and I think that the superiority of the oval over the former method is not to be for a moment doubted.

CIRCULAR METHOD. *Proceeding of Cornuau*.—The hand being supinated, and the healthy fingers held aside, the operator places the

heel of his bistoury on the crease on the palmar surface, and cuts the integuments circularly on a level with it. An assistant turns them back. In a second cut, he divides all the parts down to the bone. Lastly, he enters the joint by its anterior ligament, luxates the head of the phalanx, and finishes by dividing the lateral ligaments.

This proceeding is more difficult than the oval, which is equal to it in the beauty of its results.

(3.) *Amputation of the Four Fingers together.*

Anatomy.—We have said in the preceding article by what indications these joints may be recognized; we need only add that the articular heads of the second and fourth metacarpal bones are almost on a level. The third, which maintains the middle finger, is half a line longer; that of the little finger, on the contrary, is half a line behind.

METHOD WITH ONE FLAP. *Proceeding of Lisfranc.*—Supposing that you operate on the right hand, pronate it. Grasp the four fingers in your left hand, placing your thumb on the joint of the little finger and your index on that of the index finger; then, 1, with a narrow knife, make a semicircular incision with its convexity towards the fingers, passing from the internal side of the head of the fifth, along the points where the fingers become detached from the hand, to the outside of the head of the second metacarpal bone. An assistant draws back the skin, or the operator dissects it if necessary.

2. Draw the knife over the four joints, to destroy their dorsal ligaments; one by one divide the lateral ligaments of each joint, and then their palmar ligaments.

3. Lastly, slip the knife under the ends of the phalanges, and cut the palmar flap, first on the side of the little finger, exactly following the crease on its palmar surface; raise each finger successively to follow the knife. An assistant holds the fingers as they are detached.

The proceeding is the same for the left hand, only the knife passes in the opposite direction, that is to say, from the index to the little finger. When your hand is practiced, you may divide the lateral ligament as you open the joint; the second step is thus much shortened. The operation finished, tie the arteries if there is need, unite the wound with adhesive straps, and put the hand in a scarf in a middle position, with a small mèche in the ulnar or inferior angle of the wound.

This proceeding serves just as well for the amputation of two or three fingers; only the sound fingers must be held away by an assistant, the point of the knife must be used in forming the dorsal flap, and the incision be begun and finished on a level with the joints to be opened. The operation is still more facilitated by supinating the hand, and first cutting on the palmar surface, following the guiding crease; then pronate the hand to cut the dorsal flap, and it only remains to destroy the joints themselves.

Before the age of fifteen or twenty years, the ossification of the heads of the metacarpal bones is generally incomplete, and they are easily divided with the knife; you may then, instead of following the

articular interline, cut the cartilages off a quarter of an inch higher, and gain so much more extent for each flap.

CIRCULAR METHOD. *Proceeding of Cornuau.*—The operation is divided into three steps: 1. The hand being supinated, the operator seizes the four fingers with his left hand, and makes at the digito-palmar crease a semicircular incision, dividing successively the skin, vessels, nerves, and flexor tendons down to the joint.

2. He pronates the hand and completes the circular incision on the dorsal surface on a level with the commissure of the fingers, divides all the soft parts, and opens the joints.

3. He dislocates the heads of the phalanges, and finishes by cutting the lateral and anterior ligaments.

This proceeding appears more precise and advantageous than the preceding. It may serve just as well for the removal of two or three fingers.

(4.) *Disarticulation of the Metacarpal Bone of the Thumb.*

Anatomy.—The metacarpal bone of the thumb, thickly covered with flesh on its palmar surface, is almost bare under the skin on its dorsal. It articulates by a sort of arthrodial gynglymus, with loose ligaments, with the trapezium, the articular surface of which is concave from within outwards. You can easily make the head of the metacarpal bone project outwards, by approaching it to the index finger. On the inside the joint is separated from that of the index finger by an osseous projection a line broad, belonging to the trapezium. Lastly, the direction of the joint is oblique, in a line passing from its external side to the root of the little finger.

METHOD WITH ONE FLAP. *Ordinary Proceeding.*—If you would disarticulate the left thumb, supinate the hand; an assistant holds away the fingers, and the operator abducts the thumb; then, 1, he applies the heel of the bistoury, held perpendicularly with its point upwards, on the middle of the commissure, and freely cuts close to the bone down to the trapezium.

2. He inclines the edge towards the joint in the indicated direction, and freely enters it, slightly luxating the bone to its ulnar side, and pushing aside the soft parts from the thenar eminence.

3. The joint thus being opened, he brings the edge towards himself, grazes the radial border of the metacarpal bone, and cuts an external flap, which should comprise as much flesh as possible, and terminate some lines below the metacarpo-phalangeal articulation.

If you would give more thickness to the flap, during the first incision, incline the knife more to the ulnar border of the hand. When you reach the trapezium, sometimes the bistoury becomes fastened in a joint; you have incised too near the second metacarpal bone. By making your incision one line outside, you will find the joint desired. An inexperienced hand, in freely opening the joint, is liable to cut or jag the base of the external flap. In order to avoid this inconvenience, you are advised to withdraw the bistoury after the first incision, and to prolong the incision of the skin half an inch towards the wrist,

on the dorsal and palmar surface, and to divide the joint rather with the point than blade.

Some have wished to reverse the steps of the operation, to cut first an external flap, traversing the soft parts with the point, and dividing the joint from without inwards; a bad modification, which exposes you to penetrate between the two ranges of carpal bones. You may, at farthest, only have recourse to it in amputating the right thumb; then, in fact, for the first proceeding, the hand must be supinated, at least if you are not ambidextrous; and the operation is less easy, because you cannot so well follow the direction of the bistoury across a thickness of flesh. In any case, remember the direction of the joint, and, if you fear to lose yourself, seek it from before backwards, sawing along the metacarpal bone with the point of the knife. The operation finished, you have only the radial artery to tie, towards the upper end of the second metacarpal bone; you may even avoid wounding it, by exactly grazing with the knife the extremity of the first metacarpal bone, and keeping carefully away from the second. Then you have only injured small branches of the dorsal artery of the thumb, which generally do not need ligature; bring the wound together with strap-ping.

Proceeding of Velpeau.—Make an incision on the dorsal surface, extending from the styloid process of the radius to the commissure between the thumb and index fingers, dividing the skin, the tendon of the extensor longus, and a part of the first interosseous muscle, and uncovering the joint; an assistant holds apart the lips of this incision. The operator then divides the articular capsule, dislocates the metacarpal bone and removes it, preserving as much flesh as is necessary to immediately close the wound. It is a sort of flap with a palmar base.

OVAL METHOD. Proceeding of Scoutetten.—If you operate on the left hand, supinate it and make a longitudinal incision, commencing one line above the articulation of the trapezium, and reaching the digital commissure on the internal side of the first phalanx of the thumb; divide all the soft parts down to the bone, then pronate the hand, and carry on the incision; continue it on the dorsal surface, exactly following the direction of the upper crease on the palmar surface to the part where it commenced, so as to form, by the union of its two branches, an angle of about 30° . Then divide the muscles that adhere to the bone, viz. all along the bone on its dorsal surface, but only the upper half on its palmar. Then open the joint by its dorsal surface; when you have completely traversed it, dislocate the metacarpal bone outwards, and, grazing the internal surface of the bone, detach it from the flesh.

For the right thumb, the first incision should be made on the radial side.

Author's Proceeding.—The proceeding last described does not sufficiently expose the joint to allow you to destroy it promptly and easily, and, when the operation is made, the loss of substance of the point of the V leaves the trapezium projecting through the wound. I commence by a vertical incision, which ascends half an inch above the

joint, and descends one inch below it; the oval incision begins and ends on the inferior end of this incision.

Appreciation.—The easiest of these proceedings is undeniably the ordinary; but the oval gives much the best results, and should be preferred as a general method. The proceeding of Velpeau is more difficult than the oval, since there is only one incision, does not give a better result, and is only suitable in exceptional cases.

(5.) *Disarticulation of the Metacarpal Bone of the Little Finger.*

Anatomy.—This is a simple arthrodial joint, but continuous with the articulation of the fourth metacarpal bone and wrist, and of the two last metacarpal bones together. It results that it has proper ligaments only in front, behind, and on the inside; on the outside, the interosseous ligament belongs to the junction of the two metacarpal bones, and is destroyed by the simple introduction of the bistoury between them.

The surface of the unciform bone that receives the fifth metacarpal is concave from behind forwards, and also slightly from within outwards. You cannot then freely traverse the joint, but you may enter it very easily half way from within outwards, following the direction of a line that would reach the middle portion of the second metacarpal bone.

METHOD BY FLAP. Proceeding of Lisfranc.—The hand being pronated, begin by assuring yourself of the position of the joint. This you may do by carrying your finger along the ulnar border of the metacarpal bone until it meets an eminence which is prolonged into a projection on the palmar surface. This is the unciform process; immediately below it is the joint.

You can also perceive the articular interline on the dorsal surface, and assure yourself of it by moving the bone.

Then the operator, grasping and drawing up as much flesh as possible with his left hand, plunges a bistoury perpendicularly from the dorsal to the palmar surface across the skin and muscles opposite the ulnar side of the joint, and grazes the bone all down with the edge of the knife; and thus cuts a semi-elliptical flap, which he finishes a little beyond the head of the phalanx.

Next, an assistant holding away this flap, the surgeon dissects the skin from the dorsal surface of the bone, without including the extensor tendon; then, seizing at the same time this skin and the soft parts, and dragging them away, he plunges in his bistoury, still cutting from behind forwards, and a little from without inwards, so as to graze the bone without wounding the skin on either side; and freely divides, from above downwards, all that he meets with to the digital commissure.

Lastly, he carries the edge on the ulnar side of the joint, enters it, following the direction pointed out, and incises the dorsal ligament with the point; then to cut the two metacarpal ligaments, plunges the point of the bistoury obliquely between the two bones, its edge turned towards the wrist, and makes the blade enter by elevating the handle; then the joint is opened on three sides, and you need only

draw away the bone to finish with the point of the knife the section of the muscles and palmar ligaments.

It has been proposed to commence the operation of the second step of the above proceeding, freely incising the interosseous space from the digital commissure to the unciform bone, dividing the interosseous ligament at the same time.

You may next disarticulate the bone, or first cut the ulnar flap.

OVAL METHOD. *Proceeding of Scoutetten.*—If you operate on the left hand, strongly pronate it, and begin one line above the articulation; an incision going straight to the ulnar border of the first phalanx, as far as the internal extremity of the digito-palmar crease, and passing round the base of the finger, exactly following this crease; leaving this first incision, grasp the little finger and carry the knife between it and the ring finger, finish dividing round the base of the finger; return on the dorsal surface of the metacarpal bone, and rejoin the first incision at a very acute angle; then isolate the bone from the flesh, and destroy the articular ligaments with the edge or point of the bistoury, as we have directed.

For the right hand make the external incision first.

This proceeding has the same inconveniences as that for the thumb, and I have modified it in the same manner. The operation is not so easy by this method as by the first; but its result is a little better, as you have only one linear cicatrix.

(6.) *Carpometacarpal Disarticulation of the Index, Middle, and Ring Fingers.*

These operations are rarely performed to remove but one finger. It is necessary in these cases especially to study on the skeleton the direction of the joint to be destroyed. The means of union are always dorsal and palmar ligaments, and on each side the interosseous ligaments, which keep together the metacarpal bones.

It has been proposed to incise freely the interosseous space on one side of the bone, from the digital commissure, to prolong the incision of the integuments half an inch each way, to destroy the ligaments, and when the bone is disarticulated to bring back the bistoury on the other side, grazing the bone to the other digital commissure; the metacarpus would thus be divided through its whole length and thickness by a loss of substance, in the shape of a V.

We much prefer the *oval method* applied here by Langenbeck. An incision is made, starting some lines above the joint obliquely to the digital commissure, passes round the base of the finger, exactly in the palmar crease, divides the other commissure, and returns to the point whence it started. It remains to divide with the point of the knife the interosseous ligaments, as we have described, and the palmar ligaments by opening and luxating the joint; there is thus only a lineal wound on the dorsal surface. This proceeding should also be modified as those of Scoutetten for disarticulation of the thumb and little finger.

(7.) *Carpo-Metacarpal Disarticulation of the Four Fingers together.*

Anatomy.—We have said that these articulations have only dorsal and palmar ligaments, with the exception of the fifth metacarpal, and the external ligament of the index. The only important thing is to know how to distinguish the internal and external sides of the joints, and the direction of their articular surfaces. We have said how you may find the joint of the little finger. To find that of the index, seek on the dorsal surface the point where the two first metacarpal bones approach each other; the general direction is nearly transverse. The second metacarpal articulates at the same time with the trapezium, trapezoid, and os magnum; the interline is zigzag-shaped, composed of a right angle very prominent above, a right angle prominent below, and a second right angle projecting upwards. The third metacarpal bone articulates transversely with the os magnum, and the fourth almost transversely with the unciform; lastly, the joint of the last is a little oblique upwards, in the line pointed out. The synovial membranes of the first two joints communicate with that of the wrist, which makes us dread the spreading of the inflammation to it after the operation.

Operation.—Pronate the hand, and grasp it with your finger and thumb, one on each side of the joint. Make a semilunar flap on its dorsal surface, extending from one side to the other; by another incision, divide the space between the finger and thumb, in its whole length; with the point of the bistoury, divide all the dorsal ligaments in a transverse direction, excepting the zigzag of the second metacarpal, and remember the general rule, not to attempt to enter the joint.

All these ligaments being divided, and with them the internal and external, depress the metacarpus to luxate the bones; finish cutting the fibrous bands that retain the joint, then the palmar ligaments; and, lastly, gliding the knife under the palmar surface of the bones, cut a flap of suitable extent from it.

You would have a more simple operation, and a better result in dividing the integuments, by a circular incision from the internal edge of the metacarpus to the commissure of the index finger and thumb.

It would be easy to remove the thumb at the same time, or, on the contrary, to retain the index finger (A. Cooper) or the little finger (Larrey). These fingers, even alone, are of great service to the patient.

(8.) *Amputation in the Radio-Carpal Articulation.*

Anatomy.—The scaphoid, semilunar, and cuneiform form an eminence convex each way, but especially lengthwise, which is almost entirely received in the concavity of the radius; the ulnar only participating in the joint by a fibro-cartilage, and in the extent of one-third of an inch.

It is easy to find the styloid processes, beneath which the joint begins, but it is not so easy to judge of its direction. If you directly

extend the hand, and cause it to execute the movements of flexion forwards—these movements are operated in the medio-carpal articulation, and it is there the knife would fall.

The indications for avoiding this error are these:—

Strongly bend the hand backwards; the summit of the angle formed by it with the forearm indicates the radio-carpal articulation.

You can also feel in front the transverse projection of the radius; the joint is one line below it, and about half an inch above the crease in the skin that separates the palm of the hand from the forearm.

When you have well determined the summit of the styloid processes, if you draw a transverse line between them, the joint will be two lines and a half above this imaginary line.

Lastly, the styloid process of the radius being found, you know that the styloid process of the ulna is two lines shorter, and the joint is a quarter of an inch above it. These anatomical measurements I have made; but you will find more precise relations given in my “*Mémoire sur les Luxations du Poignet.*”

The circular and flap methods are employed.

CIRCULAR METHOD.—An assistant strongly drawing back the skin, make a circular incision, grazing the *thenar* and *hypo-thenar* eminences, through the skin only; dissect and raise the skin; on a level with the joint make a second incision, which divides the tendons, and enter the joint either from before backwards, or *vice versâ*, or from side to side.

Velpeau advises bending the hand forwards whilst incising the skin behind, and backwards whilst dividing the skin in front, &c. These precautions certainly better extend the skin, but they also cause you to preserve less because the retraction is greater, and the tension of the skin itself does not allow the assistant to draw it back sufficiently. It seems then that you should adopt the opposite principles; but they are not needed if you follow the line we have pointed out. Lastly, if the assistant has sufficiently drawn back the skin, the pisiform bone will be left in front of it.

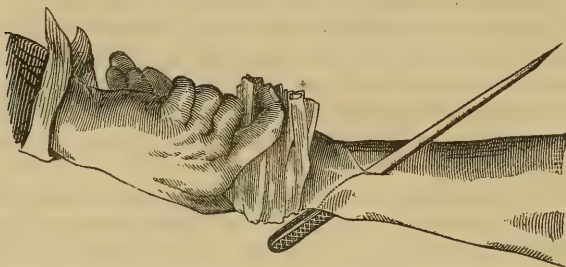
METHOD WITH TWO FLAPS. *Ancient Proceeding.*—Pronate the hand, and commence by making a dorsal flap by means of a semilunar incision. Dissect and turn back this flap; enter the joint, successively dividing the dorsal and lateral ligaments, and luxate. Then, passing the knife under the bones of the carpus, cut an inferior flap, taking care to dissect off the flap from the pisiform, or you will include it.

Proceeding of Lisfranc.—He grasps the hand as usual, and slightly pronates it, then he plunges a narrow, double-edged knife, held flat, into the soft parts, and pushes it across all the space between the styloid processes of the radius and ulna, cutting the anterior flap; next, he forcibly pronates the hand, and cuts a semilunar dorsal flap, which he dissects, and an assistant retracts.

Lastly, he re-pronates the hand, and freely enters the joint under the styloid process of the radius, and, with one semicircular cut in the direction of the joint, divides all the ligaments, and separates the hand from the forearm.

This proceeding is by far the most brilliant; it is as easy, and gives the same result as the preceding. But the results of the circular are really the best, and should cause it to be preferred.

Fig. 12.



Lisfranc's amputation at the radio-carpal articulation.

(9.) *Amputation at the Elbow.*

Anatomy.—It is not so easy as you would at first suppose to find the two sides of this joint; the two projections formed by the epicondyle and epitrochlea, which you first feel under the skin, are almost on the same horizontal plane, the axis of the humerus forming a perpendicular to it; but the articular interline has not at all the same direction. In a well made adult, I find that the internal border of the trochlea of the humerus is three-quarters of an inch below the inferior point of the epitrochlea, whilst the external border of the radio-humeral joint is only a quarter of an inch from the lowest point of the epicondyle. Two facts result: first, that the articular interline is very oblique from without inwards, and from above downwards. Second, that it is very much below the tuberosities of the humerus.

If, then, in cutting your anterior flap, you extend its base up to the level of these tuberosities, it will almost always be too short to cover the bone, which will project, especially on the inside and downwards: this often happened to Dupuytren, who put in his knife transversely at the internal and anterior part of the epitrochlea, to bring it out on the anterior border of the epicondyle. You should, on the contrary, plunge in the knife obliquely one inch below the middle projection of the epitrochlea, to bring it out half an inch below the projection of the epicondyle.

But the external side of the articulation is more easily distinguished on account of the prominence of the head of the radius, which leaves between it and the condyle a slight angle perceptible from the exterior.

The articulation of the radius with the humerus is almost transverse, and even; that of the ulna, on the contrary, very uneven, and descending obliquely outwards, as we have said, offers in front the angular projection of the coronoid process; on the inside, another osseous projection, and behind the olecranon, so that you may freely open the joint from the outside; but from the other it is completely impossible. The method with one flap and the circular are employed.

METHOD BY ONE FLAP.—The forearm being one-third flexed, and the hand completely supinated, the operator standing on the inside, marks with the left hand the sides of the joint, at the same time that he raises as much flesh as possible from the anterior surface; then he pushes a double-edged knife transversely through from the inside to the out, following the directions we have given; and, directing the edge downwards, grazing the bone, he cuts an anterior flap about three inches long; this his assistant raises.

Next, he returns to the base of the flap, and by a semicircular incision divides all the integuments in the posterior part.

Then he freely enters the joint between the radius and the humerus. Having reached the ulna, he withdraws the knife, divides all the humero-cubital ligaments with its point, dislocates the joint so as to pass a saw into it, and cuts off the olecranon, which remains fixed to the tendon of the triceps. When you are pretty expert, at the same time that you make the incision of the ligaments behind you can enter the joint between the radius and humerus. Some prefer removing the olecranon. In this case, the joint being luxated, carry the point of the knife behind to divide the lateral ligaments of this process; it then is only held by the tendon of the triceps, which you must cut across. Dupuytren followed both proceedings indifferently, without having any real motive for preferring one to the other.

CIRCULAR METHOD. *Proceeding of Cornuau.*—The operator stands on the outside of the limb, and makes a circular incision through the integuments three fingers' breadth below the joint. An assistant retracts the skin. A second incision divides the soft parts down to the bone. Next he carries the knife to the anterior part of the joint, and cuts successively the tendon of the biceps and brachialis anticus, and the anterior and lateral ligaments. Lastly, he dislocates the joint by a movement of traction downwards on the forearm, and divides the tendon of the triceps.

M. Velpeau, after dividing the skin, dissects it to a level with the joint; there he divides the muscles whilst disarticulating. This modification has the double advantage of making a thin flap without muscles, which favours immediate reunion, and leaving the trunk of the humeral artery only to be tied, whilst with the muscular flap the artery is divided after its bifurcation. It seems, then, preferable.

(10.) *Amputation in the Scapulo-humeral Articulation.*

Anatomy.—The articulating surface of the head of the humerus represents almost a hemisphere, of which the glenoid cavity receives scarcely one-third. The rest is contained by the extremely loose articular capsule. The osseous surfaces are maintained in contact, principally by the deltoid, supra and infra spinatus, teres minor, and subscapularis muscles, and, in addition, by a fibrous lamellated tissue that attaches the head of the humerus to the acromion process. Above the articulation extends an osseo-fibrous vault, formed by the acromion and coracoid process and the ligament that unites them. This vault is a quarter of an inch above the head of the humerus, projects an inch beyond the glenoid cavity, and descends on each side a little

more behind than in front, so as to be more than an inch high. You may find more precise information in my Memoir on Scapulo-Humeral Luxations, in the *Journal des Progrès, année 1830*.

From these considerations, it will be seen that the projection of this vault forms the principal obstacle to disarticulation; the second arises from the muscles and fibrous tissue, which retain the head of the humerus below.

The method with one flap, that with two flaps—the oval and the circular—have been proposed. The proceedings have been multiplied beyond measure. We shall give under each method those that have obtained the greatest repute.

METHOD BY ONE FLAP. (*Dupuytren.*)—The arm being held away from the trunk, grasp the deltoid in its entire length and thickness in your left hand; with your right push a double-edged knife directly through its base, immediately under the acromion, and grazing the surface of the humerus, cut an external and superior flap of sufficient extent. An assistant raises it. Then, by approaching the arm to the body, you expose the tendons of the muscles inserted into the head of the humerus. Cut them, commencing with those posterior, which are more easily divided on account of the greater interval between the acromion and the head of the humerus, than between the latter and the coracoid process, and finishing with the anterior tendons. To a practiced hand, a semicircular incision on the anatomical neck of the humerus with the edge of the knife held perpendicularly suffices. The fibrous tissue that unites it to the acromion is also divided. Then the operator, grasping the diseased arm with his left hand, dislocates the head of the bone outwards; and, passing the knife behind it, detaches the flesh that covers it, in which the nerves and vessels are comprised. At this moment, the assistant compresses these soft parts, with his thumb on the bleeding surface, and his fingers placed in the axilla, so as to compress the artery; and the operator, assured against hemorrhage, finishes dividing them, on a level with the inferior attachment of the great pectoral and latissimus dorsi to the humerus. Bring down the flap on the wound, and unite by first intention. You thus attain the same result as Ravaton and Lafaye did by a more complicated proceeding. You may, by directing the edge of the knife inwards, even open the capsule in the first cut.

METHOD BY TWO FLAPS. *Proceeding of Lisfranc.*—We must add to the relations already given that there exists between the acromion and coracoid processes a triangular space, bounded behind by the clavicle, and where the roof of the vault is only fibrous.

If you would amputate the left arm, raise it outwards almost to a right angle, stand behind the patient, and grasp the stump of the shoulder with your left hand, with your thumb on the posterior surface of the humerus, and your index and middle fingers placed on the above-mentioned triangle; then, 1, plunge in a double-edged knife, eight inches long, parallelly to the humerus at the external side of the posterior border of the axilla, in front of the tendons of the latissimus dorsi and teres major, the blade being so placed that its flat surface may form an angle of 35° with the axis of the shoulder, and that its

superior edge be a little in front. The knife grazes the superior and external surface of the humerus, and arrives under the acromion; there depress the point, and raise the handle so as to form an angle of 30° or 35° with the axis of the joint, and separate it from the arm from two to three inches; then press directly with the point, which, traversing the joint, comes out in front of the clavicle, on the internal side of the acromion, in the indicated triangle. Then, whilst the handle remains almost immovable, carry the end of the blade from within outwards, and a little from below upwards, passing round the head of the bone; once disengaged from between it and the acromion, the knife descends freely on the outside of the arm and cuts a posterior flap about three inches long, which an assistant hastens to raise. Next, 2—the operator, holding the hand depressed, and incising from heel to point with the knife, glides it from behind forwards on the internal side of the head of the humerus, depresses the handle till it becomes perpendicular to the horizon, passes along the internal side of the bone, has the artery compressed by an assistant, and finishes the anterior flap.

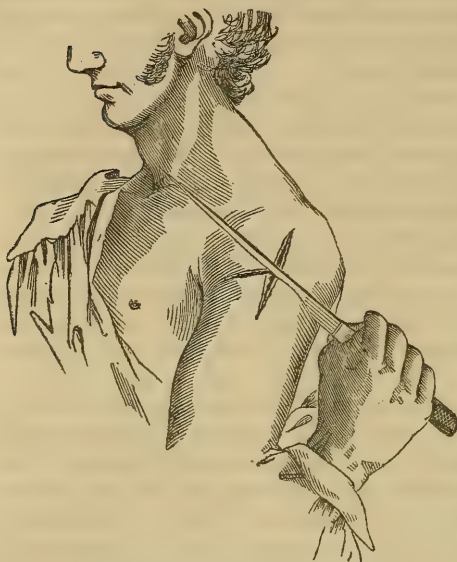
When you amputate the right arm, you may execute the first step in two ways, always using the right hand: either you plunge in the knife at the indicated triangle to bring its point out in front of the posterior part of the axilla; or the operator stands behind the patient to make the first flap, and then steps to his side to terminate the anterior.

Nothing can be more rapid than this operation. In the first step, you divide at the same time the tendons of the latissimus dorsi, teres major and minor, supra and infra spinatus, etc., a portion of the deltoid, half the articular capsule, the sub-acromial fibrous tissue, in a word, almost all the attachments of the humerus: so that the head of the humerus at once escapes from the glenoid cavity. The second step of the other proceedings, which consist in destroying the joint, is here confounded with the first. No other proceedings by two flaps offer so great advantages. When the subject is not fifteen years old, the point of the acromion is cartilaginous; Lisfranc, therefore, proposes a special proceeding, also by two flaps, and in which the knife removes the end of this cartilage. We think that, if you do choose the method with two flaps, the former is always the best plan, as there is more inconvenience than advantage in removing a portion of the acromion, which also diminishes the projection of the shoulder, and adds to the deformity.

OVAL METHOD. Proceeding of Larrey.—He commences by an incision, starting from the border of the acromion, and descending to an inch below the level of the neck of the humerus, dividing the integuments, and separating the deltoid into two equal portions. An assistant retracts the skin, and the operator makes two oblique incisions, starting from the first an inch below the acromion. The first of these ends at the anterior border of the axilla, the second at its posterior border, and both are prolonged in such a manner that the tendons of the great pectoral and latissimus dorsi may be divided near their insertions. Divide the cellular adhesions that retain these two flaps

to the bone, and draw them back, the assistant who holds them at the same time applying the extremities of two fingers on the internal

Fig. 13.



Larrey's amputation at the shoulder-joint.

and external circumflex arteries; the joint is now exposed. One cut on the upper semi-circumference of the head of the humerus divides the capsule and tendons; dislocate the head of the bone outwards, and pass the knife inside and behind it to isolate it from the soft parts: the assistant now compresses the axillary artery, and you finish the operation by transversely cutting the skin and remaining soft parts, on a level with the inferior ends of the oblique incisions. Having tied the arteries, bring the coverings together; there only remains a linear cicatrix, as after all oval amputations. Larrey commences

with the anterior oblique incision, because the circumflex artery on that side is not so large as the one on the other. This, however, is left to the choice of the operator.

The operator being obliged to stand on the outside of the limb, it is difficult to make the two oblique incisions with the right hand. Larrey changes the knife hand; but he says himself that you may make these incisions from within outwards, traversing the flesh with the point of a bistoury, and thus always using the right hand. You might also, on the left side, make the incision from below upwards, and *vice versa*. This proceeding seems rather long from the description, but it is very rapid in execution. No other of this kind gives so good results, and we much prefer it to the oval incisions of Guthrie, Dupuytren, etc., who make the summit of the V directly under the acromion. It is to be feared then (and we have seen it happen), lest the muscles and skin, retracting on each side beyond measure, should leave the glenoid cavity exposed to the air, which much retards cicatrization.

CIRCULAR METHOD.—The *proceeding of Ledran*, imperfectly understood by most authors, gives the result of a circular amputation. Garengéot advised incision round the limb, Alanson re-proposed it, and more recently, Graefe in Germany, Sanson and Cornuau in France, have recalled attention to this method, which they thought a new one. The proceeding of Alanson being the most complete, and comprising almost all the others, we shall describe it.

Proceeding of Alanson.—Four fingers' breadth below the acromion

make a circular incision through the skin; let an assistant retract it, and then divide the deltoid obliquely from below upwards, so as to reach the articulation, and with another cut divide the tendon of the biceps and the upper part of the capsule; dislocate the head of the humerus, pass a knife behind it, and the artery being compressed, divide the rest of the soft parts on a level with those already cut.

Alanson, not knowing this way of compressing the artery, replaced the fingers of an assistant by a ligature "en masse," which he removed after tying the artery in the ordinary manner; he united the wound across, and the patient recovered well. But he does not hesitate to acknowledge the difficulty he experienced in disarticulating the head of the humerus; he even advises, in order to overcome this difficulty, making an incision directly up to the acromion, which would make his proceeding similar to that of Larrey.

Sanson made his incision one finger's breadth from the acromion, and united the wound from before backwards; this is, in result, the proceeding of Larrey without the superior incision, but with more difficulty in its execution.

Appreciation.—The proceeding of Lisfranc is the most easy, rapid, and brilliant. The proceedings of Alanson and Sanson afford the best results, but at the expense of the facility of the operation.

The proceeding of Larrey unites as much as possible the two advantages, and generally deserves preference. As to the proceeding by one flap, it should be reserved for exceptional cases, where there is skin only on one side: you may, if necessary, take your flap from before or behind; necessity makes the rule.

SECTION III.—AMPUTATION AT THE JOINT IN THE LOWER LIMBS.

(1.) *Amputation of the Phalanges of the Toes.*

The last phalanx of the great toe is removed in the same way as that of the thumb; the articulation is the same, and has the same relation to the fold in the skin, seen on its plantar surface. You may also disarticulate the phalanges of the other toes, following almost the same rules as for those of the fingers.

(2.) *Amputation of One Toe.*

The articulations of the toes with the metatarsal bones are of the same kind as those in the hand, only there are generally three sesamoid bones for the great toe, two inferior and one internal; sometimes another for the second, and one for the little toe.

The proceedings are the same as for the hand, and the oval method is the best of all. Amputation of the first toe only has given rise to discussion.

After this disarticulation, the head of the first metatarsal bone makes a considerable projection difficult to cover, which rubs painfully against the boot, and leaves a disagreeable-looking deformity; on which account most surgeons since Ledran prefer amputating the first metatarsal in its length or continuity; M. Blandin objects that this head of bone serves as a resting-point to the foot essential in

standing, and that the inevitable effect of its removal is to throw the foot inwards. If this fact was constant, without doubt disarticulation of the great toe would be preferable; but Dupuytren, who saw and performed several of these amputations of the metatarsal bone, never saw this turning in of the foot. There are then reasons *pro et contra*; but the decisive one is that disarticulation is less serious than section of the metatarsal bone, and consequently is to be preferred.

(3.) *Amputation of the Five Toes together.*

Anatomy.—The nature of these articulations, as well as their sesamoid bones, has been pointed out above. It is only necessary to add that the second metatarsal is half a line longer than the first, which is situated almost on the same plane as the third; the fourth is half a line behind the third; the fifth still more behind, so that a transverse line, starting from its articulation, would fall on the commencement of the articulating portion of the first: there is some variation. Sometimes the second and third of these bones are longer, which may be recognized by the unusual prolongation of the dorsal surface of the foot on the corresponding toes. Sometimes the fourth bone is one or two lines behind.

METHOD BY FLAP. *Proceeding of Lisfranc.*—It is the same as we have described for amputation of the fingers. If then you operate on the left foot, let it be well held by an assistant; grasp the toes with your left hand, your thumb applied on the internal surface of the articulation of the great toe, and your index finger on the anterior extremity of the fifth metatarsal bone. 1st. With a narrow knife make a semicircular incision, which, starting from the internal side of the head of the first metatarsal bone, passes along the point where the toes become detached from the foot, and ends at the external side of the fifth metatarsal bone, and dissect back the flap. 2d. Draw the point of the knife from within outwards over the joints which you only half open, and then cut the lateral ligaments successively. 3d. Slip the knife under the inferior surface of the great and little toes, and successively under all the phalanges, at once; turn up the foot inwards, so as to be able to see its plantar surface, and with your left hand raise the toes towards the dorsum of the foot; then, without moving the heel of the knife, bring its point and edge from within outwards, along the crease at the end of the plantar surface, an assistant supporting the toes as they are detached.

In amputating the right foot, begin the operation on the outside, and proceed in the same manner; the arteries being tied, and the wound brought together, semi-flex the leg, and lay it on its outer surface, so that the pus may flow easily.

CIRCULAR METHOD.—The precepts and rules are the same as for the hand.

These proceedings may also serve for the removal of two or three toes, attending to the precautions pointed out for amputation of the fingers.

Moreover, the heads of the metatarsal bone are not ossified before

those of the metacarpus; consequently we may take advantage of this circumstance in the foot as well as in the hand.

(4.) *Amputation of the First Metatarsal Bone.*

This bone, extremely expanded at its extremities, has a very extensive articular surface at its posterior end, slightly concave, and articulated with the cuneiform bone. This articulation is supported by four ligaments, an internal, a dorsal, a plantar, and an interosseous.

For the indication for finding it, we refer you to *amputation of the entire metatarsus*.

OVAL METHOD. Proceeding of Scoutetten.—If the operation be on the left foot, the surgeon, after having made out the articulation, places on it the end of his left index finger; with the rest of his hand he supports the sole of the foot. He commences, two lines behind the joint, an incision directed obliquely from within outwards, to the commissure of the toes, and passes round the base of the first phalanx following the crease on its palmar surface. He then withdraws the bistoury to replace it on the internal side of the phalanx, places it in the inferior angle of the incision, ascends on the internal side of the metatarsal bone and phalanx, and by a line slightly oblique from within outwards, rejoins the point he started from. The skin being cut, divide successively in the whole extent of the incision the extensor tendons of the toe, and the fibres of the dorsal interosseous muscle. Dissect the skin from the sole of the foot, leaving the sesamoid bones on the phalangeal articulation, and exposing all the internal surface of the bone. The operator then again seeks the joint, divides the internal ligament, holding the point of the instrument perpendicular to the horizon, and the edge slightly oblique from within outwards and from behind forwards to follow the directions of the joint. Next divide the superior ligament, and then direct the edge of the bistoury upwards, and push its point obliquely at an angle of 45° into the interosseous space, formed by the external surface of the first cuneiform and the extremity of the second metatarsal bone. When the point has penetrated to the plantar layer, raise the blade again to the perpendicular, and the interosseous ligament is divided. There remain only a few muscular and ligamentous fibres, which are easily divided.

For the right foot, you mark out the joint with your left thumb, the other fingers grasping the foot by its external border, and the first incision is made on the internal side.

METHOD BY ONE FLAP. Lisfranc.—The foot being placed on a table, and fixed by an assistant, the operator seizes with his fingers and thumb the muscles and integuments on the internal side of the bone, and draws them from it as much as possible, to obtain a flap of suitable thickness; then he plunges a bistoury, held in the third position, from above downwards, between the inside of the bone and the soft parts, two lines behind the joint; cuts a flap all along the bone, and finishes beyond the metatarso-phalangeal articulation. From the base of this flap, which an assistant draws back, make an incision, crossing the bone obliquely to the internal and superior sur-

face of the metatarso-phalangeal joint. Then push the bistoury between the bones without touching the skin, as near the posterior extremity as possible, and cut directly down to the commissure of the toes; disarticulate the bone as we have shown in the former proceeding.

Instead of making a second incision after the formation of the flap, you may dissect off the skin from the base of the flap to the metatarso-phalangeal articulation, and have it drawn outwards by an assistant. The essential point is to be able to introduce the knife between the bones without jagging or cutting the integuments.

(5.) *Amputation of the Four Last Metatarsal Bones separately.*

You may amputate the fifth metatarsal bone by either of the two methods, observing the rules indicated for the first.

For each of the others, you may very well employ the oval proceeding.

In disarticulating, commence by incising the dorsal ligaments, then the lateral interosseous right and left.

(6.) *Amputation of Two Metatarsal Bones.*

Proceeding of Beclard.—To amputate the two first metatarsal bones, make an incision from the first interosseous space, half an inch in front of the joint, obliquely to the commissure of the second and third toes, passing under the crease of the first and second, and returning to join the first at the point of its commencement.

It is in fact an oval incision. Then, from the angle of this incision, draw two others, one inch or one and a half long; one directed inwards and backwards, forming an angle of 30° with the transverse diameter of the foot, the other inclined outwards and backwards, forming with the same diameter an angle of 45° .

Dissect the integuments on each side, and isolate the bones as usual; then, to reach the joints, dissect back the posterior flap, formed by the two last incisions, and disarticulate as usual. In dressing it, throw down the flap, and unite it almost as a simple oval wound.

The same proceeding would be applicable to disarticulation of the fourth and fifth, and nothing would be easier than to modify it according to the state of the soft parts, &c.

(7.) *Amputation of the entire Metatarsus.*

Proposed in 1720. Performed by Percy in 1789. Improved by Hey and Villerme; and lastly, by Lisfranc, whose proceeding is almost the only one now used.

Anatomy.—Constituted on one side by the three cuneiform bones, and the cuboid on the other by the five metatarsal bones. This articulation has an oblique direction, its internal end being two-thirds of an inch anterior to its external. This external side is easily discovered; you have only to pass your index finger along the edge of the fifth metatarsal bone; the first projection it meets is situated immediately in front of a depression corresponding to the joint; by abducting the

foot, you may also see and feel the tendon of the peroneus brevis, which is inserted into the projection mentioned.

There are five guides for finding the internal side; we give them in the order of their importance.

1. If you draw a transverse line across the foot from the tuberosity of the fifth metatarsal bone, it falls on the inside of the foot two-thirds of an inch behind the articulation.

2. In passing your finger from before backwards along the internal and inferior border of the metatarsal bone of the great toe, you meet an eminence, then a depression, then another eminence; the joint lies between these eminences.

3. In following with your finger the internal edge of the foot from behind forwards, one inch in front of the malleolus, you feel the projection of the scaphoid; the joint is one inch beyond it.

4. If you flex the foot on the leg, you can follow the tendon of the tibialis anticus, which is attached to the internal cuneiform and first metatarsal bones.

5. The point that projects most in front of the scaphoid bone being recognized, you will find the joint three lines in front of it.

These rules are generally certain, but in some rare cases the tuberosity of the fifth metatarsal bone is prolonged backwards, and even articulates with the outside of the cuboid. Knowing this beforehand, you must not be deceived.

It is also important to know the direction of the articulating surfaces.

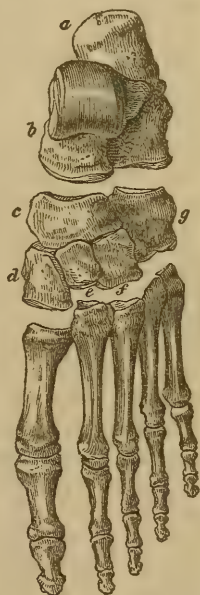
1. The external side of the joint at the union of the fifth metatarsal bone with the cuboid, has a double obliquity; first, in the direction of a line which would pass from this point to the internal surface of the first joint of the great toe; second, in the direction of another line, passing from the same point to the middle of the first metatarsal bone.

2. The joint of the fourth metatarsal bone is in the direction of a curved line, one inch long, beginning on the outside following the above-mentioned inflexions, and terminating on the inside, one-third of an inch in front of its external end.

3. The articulation of the third is usually half a line in front of the fourth, and almost transverse.

4. The second, more prolonged backwards, is lodged in a kind of mortice formed by the three cuneiform bones. The internal wall of this mortice is one-third of an inch deep, oblique backwards and outwards, and forms with the axis of the foot an angle of 5° or 6° ; the external wall, one-sixth of an inch deep, oblique behind and internally, makes with this axis an angle of 7° or 8° ; the posterior wall, half or three-quarters

Fig. 14.



a. Os calcis; b, astragalus; c, scaphoides; d, the 1st or internal cuneiform; e, the 2d or middle cuneiform; f, the 3d or external cuneiform; g, cuboides.

of an inch wide, is almost even and transverse. These relations are not subject to much variety.

5. The articulation of the first is a quarter of an inch in front of the third; it is oblique in the direction of a line passing from its internal side to the middle of the fifth metatarsal bone. We must now study the *ligaments*.

On the dorsal surface there is but one ligament for each metacarpal bone, excepting the second, which is retained in its mortice by three ligaments. The plantar are not of much importance to know; the same is not the case with the interosseous ligaments. These latter are three in number; the first or internal, the strongest, has been justly called *the key of the articulation*. It starts from the external side of the first cuneiform, and from the inside of the second to be inserted on the corresponding surfaces of the first and second metatarsal bones. The second or middle is attached to the external surface of the second cuneiform bone, and to the internal surface of the third, it goes to the external side of the second metatarsal, and on the inner side of the third. The last is implanted on one hand into the internal surface of the cuboid, and on the external surface of the third cuneiform; and on the other hand on the outside of the third, and the inside of the fourth metatarsal bone. According to this disposition, you see that the lateral walls of the mortice are only immediately applied to the second metatarsal bone, at their dorsal surface; on their plantar exist intervals filled up by the interosseous ligaments, in which the knife can enter. Such is the articulation in the normal condition, but you may find some joints fixed; often also you meet, towards the junction of the cuneiform and two first metatarsal bones, a small exostosis, especially in individuals who have worn narrow boots. The knife almost always is sufficient to overcome these obstacles.

Operation. (Lisfranc.)—He uses a small knife, with a solid, strong back, and only one edge. In operating on the *right* foot, let the patient lie on his back with his leg semiflexed, and extending beyond the edge of the bed.

An assistant holds the foot, the ends of which should be wrapped up in a cloth, and at the same time keeps it rotated inwards. The surgeon, after having assured himself of the two ends of the joint; according to the above guides, applies the palm of his left hand under the sole of the foot; his thumb on the tuberosity of the fifth metatarsal, and his index or middle finger half an inch in front of the internal side of the joint. He then makes a semilunar incision across the dorsum of the foot, from without inwards, down to the bone, half an inch in front of the articulation. The assistant retracts the skin; if the tissues will not retract, dissect them. He then attacks the articulation without displacing the fingers of the left hand, which serve as guides.

The operator then places the point of the knife on the outside of the joint, and, carrying its edge in the above-specified directions, he opens it as far as the third metatarsal bone. Arrived here, he carries the knife half a line forwards, incises almost transversely, and thus reaches the second metatarsal. Here he must above all things remember the general precept, not to engage his knife in the joint, but

to work only with its point, and to confine himself to the division of the ligaments.

When the instrument has reached the second metatarsal bone, he quits this side of the articulation to attack the inner side. The left index-finger indicates its situation. You may also apply the following plan: With the instrument held perpendicular to the horizon, its edge towards the tarsus, graze the tibial surface of the first metatarsal bone. When you feel that you have reached the head of the bone, raise the knife perpendicularly to the axis of the foot, and continue sawing towards the joint—the want of resistance shows when you have reached it. The knife enters it in the indicated direction, viz., that of a line which would fall on the middle of the fifth metatarsal bone: the handle of the knife should also be a little behind the blade, as the surface is slightly oblique. All these guides seem difficult to remember, but they are essential and really very easy to apply on the subject.

The mortice is now to be destroyed. The operator passes the point of the knife between the first cuneiform and the second metatarsal bones, with the edge of the instrument turned towards the leg, and forming an angle of 45° with the toes. When the instrument has entered to about the depth of the joint, raise the handle so as to bring it to the perpendicular, and make it pass through the internal side of the mortice without forgetting its slight obliquity inwards: you thus avoid entering the joint of the first and second cuneiform bones, and completely divide the internal interosseous ligament; then withdraw the instrument, and carry its point transversely on the dorsal ligament at the posterior part of the mortice, then from behind forwards on the dorsal ligament on the outside. All the dorsal surface is now opened: bear gently on the end of the foot with your left hand, to separate the articulating surfaces, and with the point of a knife divide from above downwards successively the external interosseous ligament, and lastly the middle. To terminate the operation, the surgeon holds the foot perfectly horizontal, and divides the plantar ligaments; these being divided, he detaches the tissues that adhere to the posterior extremity of the metatarsus, avoids the tuberosities of the first and fifth metatarsal bones, and, slipping the knife under them, grazes their under surface, with the precaution of raising the heel of the knife to follow more easily the concavity of the metatarsus. In this manner, a sufficient flap is cut, according to the extent of the wound to be covered, being about two inches long on the inner side, and one on the outer border. Its anterior edge must be almost semicircular, and cut slopingly so as to present more skin than muscle. If any large tendons be exposed in the flap, cut them off with a scissors.

This flap must cover all the wound. The superior flap is left, to prevent the bones from being laid bare above, and should only be made where there is a want of good covering beneath the foot, as it leaves the cicatrix in front and liable to be bruised or hurt in walking. For the *left* foot you must commence the dorsal incision on the inner side of the foot, but the disarticulation as usual.

If the internal cuneiform projects so much that the flap will not

well cover it, or so that there would remain a considerable cul-de-sac on its inner side, it may be cut off according to the proceeding of Hey adopted in France by Bécлар. M. Baudens, on the contrary, advises preserving the cuneiform and sawing off the metatarsal bones on a level with it. On young subjects up to the age of fourteen or fifteen years, the articular extremities of the metatarsal bones are cartilaginous. You may then cut them off one or two lines in front of the joint without needing the saw. The arteries being twisted or tied, bring the wound together by strapping; place the leg semiflexed, on its outer side; the external end of the wound is thus the lowest, and the pus easily escapes.

M. Baudens prefers cutting one flap only from the dorsal surface, so that its own weight may keep it applied on the denuded bones. This is a real advantage; but, in my opinion, it is more than counter-balanced by the inconvenience of leaving the wound in front and below.

(8.) *Amputation at the Medio-tarsal Articulation.*

Performed for the first time by Chopart, whose name it has retained. We shall describe it as improved by modern surgeons.

Surgical Anatomy.—This articulation, formed by the astragalus and calcaneum behind, by the scaphoid and cuboid in front, is in general so disposed that, if you extend the foot, you will find its external side from an inch and a quarter to an inch and a third in front of the end of the fibula—its internal side eleven lines or an inch in front of the internal malleolus—its middle portion about an inch from the tibio-tarsal articulation. Its more precise indications are:—

To find its internal side.—Follow the inner edge of the foot with your finger. The first tuberosity you meet, starting from the malleolus, is the scaphoid—the joint is immediately behind it (Richerand).

For the external side.—Passing along the outer edge of the foot from the malleolus, the first tuberosity you meet belongs to the calcaneum—the articulation is in front of it. You may also recognize the position of the tuberosity of the fifth metatarsal bone—the joint sought is half an inch behind it (Lisfranc).

For its middle and superior portion.—Extend the foot and abduct it. Then applying the finger on the union of the external with the middle third of the intermalleolar space, you follow directly the dorsal surface of the foot: the first eminence you meet is the head of the astragalus, which forms part of the joint (Dupuytren).

Moreover, on the outside of this projection is a depression easily felt on pressure, which is bounded behind by the astragalus and calcaneum, outwards by the cuboid, and inwards by the scaphoid.

As to the direction of the articulating surface—

1. It is important to know that it is changed according as the foot is flexed or extended. When the foot is flexed, the astragalus and calcaneum are almost in the same line; when it is extended, the calcaneum is at least a quarter of an inch in front.

2. The scaphoid is so prolonged towards the internal malleolus, that, in order to penetrate between it and the astragalus, the handle of

the knife must be carried towards the toes so as to form with the axis of the foot an angle of 45° , and it must follow the direction of a line passing from the internal posterior surface of the scaphoid to the junction of the posterior with the middle third of the fifth metatarsal bone.

3. In its middle third, the articulation is slightly inclined backwards towards the external malleolus, then it turns a little forwards, and, lastly, again a little backwards; so that, to enter it from the outer side, the blade of the knife should be slightly oblique forwards.

The dorsal and plantar ligaments are not very tight or of much consequence, but it is most important to know the interosseous ligament, the *real key to the articulation*. Attached on one side to the calcaneum and astragalus, on the other to the scaphoid and cuboid, it corresponds to the depression mentioned on the outer and inferior side of the head of the astragalus, and there it must be divided.

Ordinary Proceeding.—We will suppose you to operate on the right foot. First, then, you recognize the three capital points of the articulation; then, holding the foot as for the preceding amputation, place the left thumb on the outside of the joint, and your index or medius on the tuberosity of the scaphoid. Make a semilunar incision between these two points, the middle of which is half an inch beyond the articulation; then, passing the heel of the knife under the nail of your left thumb, its handle having the above-mentioned inclination, open the joint in the direction pointed out. When the joint is half opened, carry the knife in front of the head of the astragalus, cut the dorsal ligaments without penetrating between the bones, and lastly, carrying the edge of the knife to the other side of the foot, the heel of its blade inclined towards the toes at an angle of 95° , finish opening the external side of the joint marked out by the index finger.

All the dorsal ligaments being thus divided, push the point of the instrument under the external and anterior side of the head of the astragalus, with its edge directed forwards, and cut the interosseous ligament in the direction of the articular surface of the calcaneum. The joint is then wide open. Then carry the knife under the plantar ligaments, and pass it under the bones, grazing them, to cut a sufficient flap, avoiding the protuberances of the scaphoid and cuboid, and farther on of the first and fifth metatarsal bones. The foot, during this time, is kept in the horizontal position. You should raise the handle of the knife slightly, to follow more exactly the concavity of the tarsus and metatarsus.

When the foot is much swollen, it is difficult to recognize beforehand the osseous projections. You are especially liable to fall upon the articulation of the scaphoid and cuneiform bones. The presence of three articular surfaces will show the error. You should incise half an inch farther back.

In old people, the interosseous ligament is often ossified. Generally it yields to the knife; if not, you must use the saw.

In children, on the contrary, up to the age of twelve or fifteen years or even later, the bones of the anterior range of the tarsus, and

the extremities of the astragalus and calcaneum, are cartilaginous. You may then cut them with a knife, and in these cases even as far from the joint as the disease will allow. The wound should be dressed as in the preceding amputation.

M. Baudens has proposed, as for the tarso-metatarsal amputation, to make a single dorsal flap; but the inconvenience of having a cicatrix inferiorly is still greater here. Perhaps there would be some advantage in adopting the following:—

Proceeding of M. Sédillot.—The patient being seated or lying down, with his leg flexed on his thigh, seek the articulation, after which embrace the dorsal surface of the foot with your left hand, placing the heel on the edge of a table to have a sufficiently firm resting-place, that you may stretch the ligaments and separate the articulating surfaces after the ligaments are divided. Then, if operating on the right foot, with a small amputation knife, held in the right hand, make a transverse incision, commencing a few lines in front of the calcaneo-cuboid joint, and finishing on the middle of the dorsal surface of the foot, consequently outside the tendon of the tibialis anticus. From this point begin a second incision obliquely from behind forward, and from without inwards, passing round the inner side of the foot, two fingers' breadths behind the metatarso-phalangeal articulation of the great toe, and which incision is brought from before backwards, from within outwards, and from above downwards, upon the plantar surface of the foot to the point of commencement of the first incision, with which it is united. Take care to cut obliquely from below upwards, and before backwards, the external plantar ligaments, so as to leave them as free as possible from the cellular fatty tissue that lines them, and so favour immediate reunion. Dissect back the internal flap as far as the tubercle of the scaphoid, on which you guide the knife to open the joint; then cut the interosseous ligament, and, slipping the knife between the osseous surfaces, finish by dividing the deep layers of muscle on a level with the plantar incision.

For the left foot you may, after the first incision, attack the articulation on its external side, and disarticulate before cutting, the kind of internal flap which forms the essential character of this proceeding; but Sédillot prefers first finishing all the incisions.

Appreciation of the two Tarsal Amputations.—It is perfectly evident that there is no comparison when the disease will not admit of tarso-metatarsal amputation; but even when it is possible, Blandin still prefers Chopart's operation, for these two reasons: The wound of tarso-metatarsal amputation is more extensive, and it communicates with the synovial membrane of the scaphoido-cuneiform joint. But you may easily show that the extent of the wound, and especially that of the flap, is greater in Chopart's operation, even by the ordinary proceeding; and the proceeding of Sédillot refutes still more this objection; and as for the inflammation feared on account of the communication between the synovial membrane, it has never been observed. Moreover, the advantages of the tarso-metatarsal operation are palpable. The entire tarsus is preserved, the anterior lever of the foot remains greater than the posterior, and the extensor tendons of the

toes adhering to the cicatrix, aided by the tendon of the tibialis anticus, which remains inserted into the scaphoid, do not allow the heel to be turned backwards, a disagreeable accident, sometimes seen after Chopart's operation. Tarso-metatarsal amputation is then always preferable when it can be performed, and we should add that cicatrices have formed over the articular surfaces, though they were not covered by any flap (Lisfranc). You might then still try it, even when the soft parts are not sufficient to cover the bones. You may remove the cuboid, with the metatarsal bones that are attached to it, leaving the others. Mr. Key has even successfully removed the four last toes, the cuboid, and two external cuneiform bones.

(9.) *Amputation at the Tibio-Tarsal Articulation.*

Generally rejected in our day, though many renowned surgeons, Lisfranc, Velpeau, and before them the cautious Sabatier, have mentioned it, with regret at the oblivion into which it has fallen.

Velpeau proposed to make two semilunar incisions, from one inch and a quarter to one inch and a third before and behind the joint, uniting to form another semi-lune on each side, about one inch below the malleoli. The skin being retracted, you would divide the other soft parts and disarticulate, uniting the wound from before backwards. If the malleoli formed too great an obstacle to the reunion, there would be no harm in saving them off.

Lisfranc said, in his lectures, that he had examined a man whose leg had been amputated at this joint, and who still preserved the power of flexing the leg, and could, without inconvenience, walk four or five leagues a day. I at one time endeavoured to discover a good proceeding for this operation, but after a lengthened examination of the joint, and the difficulty of obtaining a proper boot for the patient, I came to the conclusion that the inconveniences counterbalanced the advantages of it, and consequently that it should be rejected. M. Baudens disagrees with this decision; we subjoin the proceeding which he has twice put in practice on the living subject.

Proceeding of Baudens.—The patient is laid on a table as for amputation of the leg. The surgeon, on his right hand, taking a small amputating knife, applies its edge strongly behind the heel on the insertion of the tendo-Achillis, cuts the soft parts down to the bone, and brings it from behind forwards, along the edge of the foot on each side to within a few lines of the commissure of the toes; these two incisions he unites by another semi-lunar, across the dorsum of the foot, so as to cut all the dorsal surface in the shape of a garter. The incision on the internal edge of the foot should not extend quite so near the plantar surface as the other, to avoid including in the flap a small bundle of muscular fibres that belong to the plantar surface. He seizes the flap thus formed, by its point with the left hand, raises it with sufficient force to dissect it freely, and isolates it from its adhesions to the osseous tissues.

It is important here to graze the bone so close that the flap may be lined by the tendons, and extensor brevis digitorum entire; and especially to preserve the dorsalis pedis artery in its whole length. In

this way, it is detached to the level of the articulation, immediately above the projections of the malleoli; this done, he divides the thin and transparent fibres of the anterior articular ligament, and lays bare the inarticular line. Without penetrating further into the joint, he applies the saw on this interline, and cuts transversely from before backwards, removing not only the projections of the malleoli, but also the posterior border of the socket of the tibia in order to level the surface, so that the cartilage preserved only in front and in the middle does not form more than one-third of the osseous surface. Lastly, he retakes the knife and cuts from before backwards the ligaments and soft parts left by the saw, and finishes by dividing the tendo-Achillis, taking care to graze the posterior surface of the calcaneum, to preserve as much length as possible to the tendon.

There are only two arteries to be tied, the dorsalis pedis and the tibialis posticus. If compression is not made in the groin on the crural, it is easy for the assistants to seize these arteries during the operation.

The flap rests by its own weight on the wound, and is united by suture. Baudens advises uniting by a point of suture the tendo-Achillis to the extensor communis tendons. This suture failed with his first patient, and he does not mention its result on the second.

As may be seen, this is rather an amputation in the continuity, but it differs from other amputations of the leg, inasmuch as the patient can walk on the stump; of the two patients one died, but not apparently from the operation; "the other walks well," says Baudens, with a mechanical boot. Finally, that which appears to me to be the most clear result of this experiment is the possibility of cutting off the leg lower than it had been done before; and of preserving, perhaps with less danger, but at all events at a less cost, the free play of the femoro-tibial articulation.*

* Mr. Syme performed this operation by antero-posterior flaps, the soft parts of the heel being included in the posterior flap, and the flaps meeting in front of the anterior margin of the lower end of the tibia. He says that in twelve cases in his own practice, and in nearly as many more in that of other practitioners, this operation has not in a single instance been followed by either the death of the patient or exfoliation of the bone. Dr. Handyside recommends in preference a method by antero-lateral flaps. The operation is described as follows: A strong bistoury was entered in front of the joint, and midway between the malleoli. From this point an incision was carried forwards, over the side of the instep, in a semicircular direction, and then downwards to the middle line of the foot, terminating immediately in front of the ball of the heel. The extremities of this incision were met by another and a similar one on the outer aspect of the joint, the second one terminating where the first had been commenced. The flaps were then dissected backwards—the tendo-Achillis was easily divided at its attachment to the os calcis—and the separation of the foot was readily accomplished. The malleoli were removed by the saw, and along with them about one-eighth of an inch of the lower end of the tibia, although the cartilaginous surface of the latter was not diseased. The anterior tibial and external plantar arteries were tied. After the introduction of the sutures, which were five in number, the flaps covered the bone completely, and the flesh of the ball of the heel was situated, as in the antero-posterior flap operation, below the extremities of the bones. A bandage was then applied to support the stump. The flaps united almost entirely by the first intention, and a month afterwards the patient could rest his weight on the stump; the ball of the heel continued to form an excellent cushion beneath the ends of the bones; the cicatrix was situated vertically on the fore part of the stump; it did not exceed two inches in length; and the leg was only an inch

(10.) *Amputation in the Femoro-Tibial Articulation.*

This is another of those operations too inconsiderately condemned, which, when you have a choice, should be preferred to amputation of the thigh, in the continuity. It may be performed in three ways.

METHOD BY FLAP. *Proceeding of Hoin.*—The leg being extended, make a semicircular incision beneath the patella in front of the joint, reaching back to near the posterior border of the condyles of the femur; then flex the leg, and freely open the joint; with the point of your knife cut across the lateral and crucial ligaments; and, grazing the posterior surface of the tibia and fibula, cut a flap from the muscles of the calf large enough to cover the entire wound.

Petit cites a case in which the patella was left, and became so annoying that it was a question whether it should not be removed; he advises removing it in the operation. Velpeau, who preserves it, declares that it is no inconvenience. It is a question that does not appear to us well settled, and which requires new facts; but in any case you must take care to remove the inter-articular cartilages.

CIRCULAR METHOD. *Proceeding of Velpeau.*—Incise the skin circularly, three or four fingers' breadths below the patella, without dividing the muscles; dissect it back, retaining with it all the adipose tissue that lines it; then successively divide the ligamentum patellæ, the lateral and crucial ligaments, and finish by dividing at one cut all the soft parts in the ham, on a level with the retracted integuments.

Cornuau also makes a semicircular incision, but in it he comprises all the muscles. The question between these two modes of action is not yet decided.

OVAL METHOD. *Proceeding of Baudens.*—Draw with a pen, starting from the crest of the tibia, three fingers' breadths below the ligamentum patellæ, a line ascending obliquely backwards, from below upwards, towards the popliteal space, and terminating two fingers' breadths below a line corresponding to the ligamentum patellæ; an assistant draws back the integuments of the knee, and the surgeon cuts on the line he has traced with the pen; the skin is then reflected to a level with the joint, and the muscles and ligaments cut on the level with it; then the anterior portion of the integuments is brought back, so that the articular surfaces are completely covered by it, and the cicatrix, being behind and above the level of the condyles of the femur, is out of the way of pressure in the wooden leg.

The result obtained by this proceeding is truly admirable on the subject, and everything indicates that it would have on the patient great advantages over the other methods. I give it absolute prefer-

and a half shorter than the other, so that the patient could walk easily with a high-heeled padded shoe.

This operation is inapplicable in some instances, as in severe injuries at the ankle-joint with extensive contusion and laceration of the soft parts, or acute gangrene of the foot, &c., and therefore it cannot entirely supersede amputation of the leg; still it has been performed in more than twenty cases in Edinburgh, all the patients, except one, recovering, and no doubt can be entertained that it is less dangerous to life.—Dr. Ranking's Half-Yearly Abstract, vol. ii. p. 264.

ence; but perhaps the trace with the pen is a superfluous precaution. The immense advantage of this disarticulation over amputation in the continuity is that it preserves to the patient the free play of the coxo-femoral articulation. If through disease of the knee, you could not have recourse to disarticulation, perhaps you would obtain a similar result by cutting the thigh as near as possible to the condyles, and covering the osseous surface with a large anterior flap. This very simple idea is in accordance with the most useful rule of amputations: viz., to operate as far as possible from the trunk. I can scarcely understand how it has escaped the observation of surgeons to the present day.*

(11.) *Amputation at the Coxo-Femoral Articulation.*

Anatomy.—This articulation, very deeply situated, and surrounded by muscles, can only be felt anteriorly. Lisfranc has given four indications:—

1. Let fall from the superior spine of the ilium a perpendicular line one inch and five lines long; half an inch inside its extremity you will find the external anterior surface of the joint.

2. From the anterior inferior spine of the ilium, let fall a perpendicular line, half an inch long; its extremity corresponds to the upper part of the joint.

3. If you draw a line from the spine of the pubis, transversely outwards for two inches, a perpendicular a quarter of an inch long, descending from its extremity, will fall upon the joint.

4. Lastly, draw upwards a perpendicular line half an inch long, from the anterior superior, and external part of the great trochanter, another line one inch long at right angles to its extremity, directed inwards, will reach the external side of the head of the femur; but this relation varies according to the length and inclination of the neck of the bone. Lisfranc does not offer these indications as mathematically correct; but, as he says, it is better to have even approximate guides than none at all.

* Mr. Syme, Professor of Clinical Surgery in the University of Edinburgh, has introduced the practice here suggested by M. Malgaigne. From an analysis of the occurrences that render amputation of the thigh necessary, he concludes that, taking merely the morbid condition into account, all the cases admitting of amputation at or below the middle of the thigh-bone will admit of the operation being performed through the condyles. His reasons for preferring amputation through the condyles to amputation through the shaft of the bone are: Dense bones die more rapidly than those of a spongy or cancellated structure. There can be no doubt also that inflammation of the medullary membrane, and consequent suppuration of it, with inflammation of the veins, may co-operate, if it does not sometimes exclusively produce the death of the bone. As conclusive evidence in support of this opinion, Mr. Syme mentions those conical-shaped exfoliations extending up the interior of the bone. His mode of operating is as follows: Having applied a tourniquet so as to compress the artery where it enters the popliteal space, he makes a semilunar incision in a line with the lower edge of the patella, and then pushes the knife from one side to the other under the joint, cutting a flap from the calf of the leg: this posterior flap requires to be very long, to the full extent of the gastrocnemius muscles, care being taken not to preserve more than a moderate thickness: and finally he saws through the condyles of the thigh-bone, so as to remove the whole articulating surface.—See London and Edinburgh Monthly Journal, May, 1845.

In order to reach the joint without being stopped by the different processes round it, it is well to know the following relations :—

1. The great trochanter is directed upwards and backwards, is slightly curved from without inwards, and forms a projection of three-quarters of an inch above the neck of the femur.

2. The small trochanter projects six lines, on the internal surface of the bone; its upper border, six lines long, forms almost a right angle with the axis of the bone. Its inferior border, generally one inch long, forms an angle of 50° with the same axis.

3. The patient lying on his back, the sciatic tuberosity extends one inch and five lines below the cotyloid cavity.

Some other directions are necessary for disarticulating. The cotyloid cavity is too shallow to hold the entire head of the femur; this latter forming more than a hemisphere, is so enveloped in its fibrous capsule, that it remains there as if strangled, unless the capsule be divided very near the edge of the cotyloid cavity.

In this part of the operation, you must remember that the circumference of its transverse plane, on which falls the neck of the femur, is oblique, outwards, downwards, and a little backwards, so that the knife may follow this direction exactly. The internal ligament is so placed that, if the thigh is abducted, it is stretched by the head of the femur, and presents itself to the knife. If, on the contrary, you commence by dividing the capsule on the outside, the thigh should be adducted; the ligament is then loose, but it does not at all hinder luxation, and may easily be divided.

As to the formation of flaps, in the different proceedings, we must remark: 1. That the articulation, more superficial in front than anywhere else, is there only covered by the ends of the psoas and iliacus muscles, a little on the outside by the rectus, on the inside by the pectineus and vessels.

2. That behind and on the inside it is separated from the skin by an enormous mass of muscles.

3. That on the outside, although far enough from the skin, there only remains after the removal of the bone a very thin flap, all the intermediate space being occupied by the neck of the femur, and great trochanter.

4. That consequently to obtain two flaps of equal thickness, you must separate them in a line passing from the great trochanter to the other end of the diameter of the limb.

5. Lastly, and it is important—the crural artery corresponding superiorly to the union of the middle and internal thirds of the head of the femur, and only becoming parallel to this bone, two or three inches below, there exists, between it and the neck of the femur in a great part of this interval, a distance of one inch and five lines, which allows you, in many proceedings, to pass the knife round the neck of the bone without wounding the artery, and then to have it compressed before the flap is cut. The profunda, following exactly the same course as the crural to at least one inch and three-quarters below the little trochanter, is also out of the way of the knife.

All the methods have been advised for this operation, varied by a host of proceedings. We shall only give the most remarkable.

METHOD WITH ONE FLAP. *Proceeding of Lalouette.*—The patient lying on his sound side, the operator makes a semicircular incision from the upper and external part of the great trochanter to the tuberosity of the ischium, dividing all the soft parts down to the joint. The articulation being now recognized, an assistant rotates the limb inwards, and the surgeon divides the posterior and external part of the capsule and the round ligament with a probe-pointed bistoury; then the thigh is flexed on the abdomen so as to dislocate the head of the femur; then the joint is traversed, and the knife, passing along the inner side of the limb, makes an anterior internal flap of four or five fingers' breadths. Lalouette compressed the artery by means of a tourniquet. Lenoir, who revived this proceeding, is contented with having it compressed by the hand of an assistant in the thickness of the flap; others tie it beforehand by a special incision.

Most of the proceedings with one flap are only imitations of this. Plantade does it in three incisions, after the manner of Ravaton. Manec cuts it from within outwards, plunging his knife in the middle of the space that separates the trochanter from the iliac spine, to a little before the ischium; the flap is not so wide, and more anterior. Baudens, who adopted this proceeding, commends opening the capsule with the edge of the knife when cutting this anterior internal flap. Delpech made the flap altogether on the inside, after having tied the artery. The flap detached, you may either disarticulate first, and then divide the rest of the soft parts, or *vice versa*.

METHOD BY TWO FLAPS, performed by two principal proceedings of which the others are only varieties; these two consist in making lateral, or antero-posterior flaps.

Proceeding of Bécclard. Antero-Posterior Flaps.—The patient is laid on his back, with the thigh semi-abducted; the scrotum carefully held out of the way, and the artery compressed in the groin; the surgeon, standing on the outside of the limb, assures himself of the position of the great trochanter, and enters a long double-edged catlin one inch above the summit of this process. The instrument, grazing the bone as much as possible, is brought out on the inside of the limb, at the point diametrically opposite to that of its entrance; then the knife is carried along the anterior surface of the femur to near three inches below the joint, where the anterior flap is terminated; then the knife is carried transversely on the capsule, or any soft parts that still cover the joint; the articular surfaces separate, and the round ligament is divided. The knife is then passed behind the head of the bone, which it grazes to about three inches below the joint, where the second flap is terminated.

Velpeau describes this proceeding in a different manner. According to him, Bécclard first made the posterior flap, then the anterior, and finished by disarticulating; the result is the same.

Proceeding of Lisfranc. Two Lateral Flaps.—In operating on the left limb, the surgeon stands outside, and a little below the joint; the patient lying on his back with the sciatic tuberosities a little way be-

yond the inclined plane on which he rests; an assistant holding the limb extended and semi-abducted, if possible. The guiding points of the articulation being well recognized, according to the given indications, and especially that which corresponds to the external and anterior surface of the joint, a long interosseous knife with a narrow thick blade is plunged in here perpendicularly, with its inferior edge opposite the summit of the great trochanter. The point of the instrument, having reached the head of the femur, is passed round its external surface; but it is *indispensable* that, as it goes deeper in, the handle of the knife be inclined upwards and outwards, so as to form with the horizon and axis of the trunk an angle of 50° to 55° , and to bring out the point a line or two below the sciatic tuberosity; to effect this better, an assistant, or the surgeon himself, seizes and draws to the outside as much of the tissue as he can from the posterior region of the thigh.

The knife being pushed through, always retaining the inclination indicated, with its inferior edge towards the summit of the great trochanter, is carried with a sawing motion round that process and along the femur for about two inches, and is then brought out, the external flap being cut. Assistants immediately raise it, and place their fingers on all the bleeding arteries, which should be tied before proceeding further. This is the *first* step of the operation.

In the *second* step, the operator pushes all the soft parts inwards with his left hand, plunges the point of his knife below the head of the femur on the inside of its neck—one edge upwards, the other downwards, but taking care that the instrument be a little inclined to the patient's belly, forming an angle of 60° with the horizon. Then the knife is carried along the neck of the bone, and is brought out, without striking the bones of the pelvis in the posterior superior angle of the solution of continuity. Then the instrument (become perpendicular to the horizon) passes along the femur for about two inches, avoiding the trochanter minor by being carried slightly inwards. As soon as the incision will allow, the artery in the flap must be compressed by an assistant; and, lastly, then the internal flap is terminated of the same length as the external.

In a *third* step, the femur is seized in the left hand, and the edge of the knife carried perpendicularly on the internal side of its head which is circumscribed as much as possible. The capsular ligament is cut without entering the joint, and *as if you wished to leave half the head of the bone in the cotyloid cavity*; then the joint is wide enough open to admit the point of a knife, to cut the round ligament. Lastly, carry the knife perpendicularly on the internal side of the joint, and cut the rest of the capsule and any fasciculi of fibres that may have remained, from within outwards. In operating on the right thigh, in order to use the right hand, the surgeon must stand against the trunk at the side of the joint which he is about to attack.

Dupuytren described in 1813 a proceeding similar in its result; but he cut the flaps from without inwards, which rendered the operation more tedious.

OVAL METHOD.—It has given rise to two principal proceedings, distinguished by the situation of the wound.

Proceeding of Larrey.—It is very like that of Lisfranc and Dupuytren. We give the description of the author himself.

The surgeon, standing on the inside of the thigh, commences by tying the crural artery. For this purpose, he makes with a scalpel an incision parallel to the vessel, commencing immediately below the crural arch, and descending two inches and a half below it. He isolates the crural artery and vein from the nerves, passes a strong ligature under them, and ties it over a roll of linen, so as to perfectly compress them; the end of the ligature is fastened to the belly with a bit of adhesive plaster and left to an assistant. This being performed, he divides the skin all round the limb by a circular incision, commencing behind, immediately below the great trochanter, and continuing in a straight line towards the fold of the nates, then inwards, then forwards to the place where it begun. Then he cuts the internal flap, by prolonging the longitudinal incision that served in tying the artery down to the circular, causing the knife to act from within outwards, or from without inwards, according as the parts are more or less untouched; uncovers the inside of the joint, cuts the capsule and round ligament, then luxates the head of the femur inwards, and, traversing the articulation, bringing the knife to the outside of the bone, finishes the division of the soft parts, falling on the preliminary incision of the skin. In this section are comprised the ischiadic arteries and the gluteal, which he ties immediately, collecting the ligatures to the inferior angle of the wound. Larrey unites by suture and strapping, with the precaution of placing in the inferior angle of the wound a small tent dipped in oil of sweet almonds, passed in to the cotyloid cavity to prevent the accumulation of pus there.

Proceeding of Cornuau.—The patient lying on his healthy buttock at the end of the bed, the surgeon stands opposite the joint, and applies the three first fingers of his left hand (if he operates on the right side, and *vice versâ*) on the summit of the great trochanter, whose position he thus recognizes. An assistant adducts the limb. Commence with an ordinary straight knife, one inch above the great trochanter, a first incision descending obliquely towards the anterior region of the thigh as far as the right angle that would be formed by the meeting of two lines, one extending horizontally from the tuber ischii, the other descending perpendicularly from the anterior superior spine of the ilium. In this incision, which in an adult man is from five to seven inches long, you cut from above downwards the skin, cellular tissue, the anterior edge of the gluteal muscles, the external edge of the rectus anticus, and nervous and vascular branches of no importance. Then behind make a second incision of equal extent, forming with the first an acute angle, corresponding to the summit of the great trochanter, and extending downwards and backwards to the prolongation of the transverse line above mentioned. It comprises the rest of the gluteus maximus, the gluteal arteries, the sciatic nerve, and all the muscles that are inserted into the digital fossa of the great trochanter. By means of these two incisions, the joint is widely exposed on three sides. Divide the capsule, dislocate the femur outwards, traverse the joint, and place your knife on the inside of the neck of the femur. At

this moment, an assistant standing on the outside compresses the artery in the anterior flap; another maintains the integuments of the internal region, and draws them towards the pelvis; whilst the operator, grasping the thigh with his left hand, grazes the bone with the knife to the termination of the two first incisions, and finishes the division of the flesh and skin in one cut two inches below the sciatic tuberosity.

An almost similar proceeding has been described by Guthrie and by Scoutetten, who says he had it from Belmas. But Guthrie makes the summit of his incision nearer the superior spine of the ilium, and Scoutetten completely divides the soft parts before disarticulating. Though the proceeding of Cornuau, in our opinion, has the advantage over those of the same kind, we blame it as not always preserving enough skin to cover the wound. And if this inconvenience happened to him on the dead subject, as we saw it, what would it be on the patient? The author has even proposed to obviate it by a preliminary incision of the skin on the inside of the limb, a little lower down than the muscular incision, which prolongs the operation, without giving a satisfactory result. I would apply here also the modification I have pointed out for most of the oval proceedings. It is, moreover, almost the same as the proceeding indicated by Ravaton, the details of which were so justly criticised by Lisfranc, but the essential idea of which does not deserve the same blame.

I make a longitudinal incision down to the bone, about three inches in length, from half an inch above the great trochanter; from the middle or lower end of this incision, according to the extent of skin to be preserved, I commence before and behind the two oblique incisions that form the superior part of the oval. The rest of the operation as M. Cornuau directs.

CIRCULAR METHOD. *Proceeding of Abernethy.*—He does almost the same as for amputation in the continuity; that is to say, circularly incises the skin a few fingers' breadths below the articulation, then the muscles, and lastly detaches the tendons, and disarticulates. He reunites the wound from before backwards with strapping.

The proceeding of Graefe differs from this only in the incision of the muscles, which he hollows out into a cone after the manner of Alanson.

Appreciation.—Whatever be the method preferred, it appears to us, from the anatomical relations, that the union should be made in the direction of the diameter that would end at the extremity of the trochanter. We prefer the proceeding of Lalouette to that of Delpech, the proceeding of Béclard to that of Lisfranc, the proceeding of Cornuau to that of Larrey. As to the methods themselves, the circular affords as good a result as the oval, but is more difficult. I gave in the first edition of this book an absolute preference to the oval method, modified as I have said; but since then a more attentive examination has forced me to allow that the method with one flap, as modified by Lenoir, Manec, and Baudens, renders the operation easier and quicker, and the result is quite as satisfactory.

PART III.

SPECIAL OPERATIONS.

CHAPTER I.

OPERATIONS PERFORMED ON THE EYES, OR ART OF THE OCULIST.

WE shall treat successively under this title of the operations performed on the lachrymal apparatus, on the eyelids, on the muscles of the eye; and, lastly, of those that affect the globe of the eye itself.

In most of these cases, in operating on the left eye, you can use your right hand with facility; but for the right eye you are recommended to hold the instrument in your left hand, a practice often imprudent, always difficult; some surgeons, to escape this inconvenience, have had their instruments bent so as to be used over the projection of the nose, with the right hand. I have for a long time rejected both plans, and established this new principle, which seems to me one of great importance.

In all those cases in which the surgeon is advised to operate with his left hand, he should stand behind or on one side of the patient, and use his right.

SECTION I.—OPERATIONS PERFORMED ON THE LACHRYMAL APPARATUS.

(1.) *Catheterism of the Lachrymal Passages.*

The lachrymal passages are sounded for several purposes—to inject them, to immediately destroy momentary obstruction, or to operate a gradual or permanent dilatation, by leaving a foreign body in them for some time. The sound is introduced according to circumstances, by the superior or inferior lachrymal punctum, or nasal canal.

I. BY THE INFERIOR LACHRYMAL PUNCTUM.—The inferior punctum is the orifice of the inferior lachrymal duct, which, after passing down perpendicularly to the extent of one line, turns off to the lachrymal sac at almost a right angle; you can easily straighten its direction by drawing the lower lid strongly outwards and slightly downwards; but it forms another right angle with the lachrymal sac and nasal duct, which hinders the sound from penetrating farther, on which account catheterism by this passage is only performed for making injections.

Seat your patient opposite the light. If you operate on the left eye, stand before him, and with the thumb or fingers of your left hand draw the lower lid outwards and a little downwards, so as to

carry the lachrymal punctum forwards and outwards. Then holding an *Anel's* syringe as a pen in your right hand, which you rest on the cheek, carefully introduce the golden end of the canula into the punctum; first obliquely downwards and inwards, then, after having passed one line, directly inwards. At a depth of three lines and a half, you may stop; but it is better to go as far as four and a half to reach into the sac; then inject. On the right eye, to avoid the necessity of doing as some tell you, viz. using the left hand, stand behind your patient, and steady your hand on the external orbital process of his frontal bone.

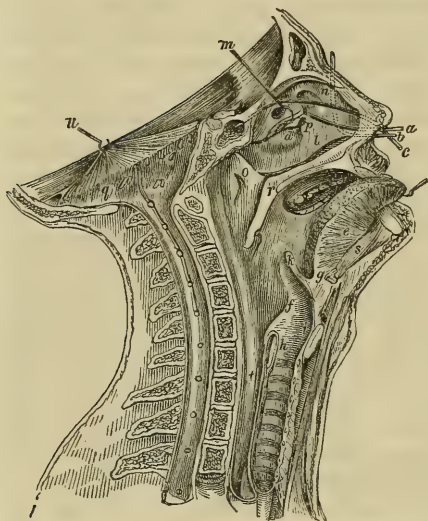
II. BY THE SUPERIOR PUNCTUM.—Starting from the superior lachrymal punctum, the superior duct ascends perpendicularly in the extent of about one line; then turns inwards to reach the lachrymal sac. It then takes, when the lids are shut, a transverse direction, which becomes oblique downwards and inwards when they are open. There is no need of changing the hand according to the side for this operation. The patient is seated opposite the light, with his head thrown back a little; the surgeon standing in front, raises the lid, drawing it slightly inwards with the left thumb or index finger; with his right hand leaning on the forehead, and holding one of *Mejean's* stylets as a pen, he introduces its oval extremity into the lachrymal punctum, first from below upwards; then, after passing in one line, obliquely from without inwards and from above downwards in the same direction as the free edge of the lid, from the lachrymal punctum to the commissure. When you reach the sac, let go the lid, bring the stylet inwards perpendicularly, and push it from above downwards, until it has penetrated into the nasal fossa, where its presence is announced by a slight tickling, or perhaps the effusion of some drops of blood.

III. BY THE NASAL DUCT. (*Called the Method of Laforest.*)—The nasal duct is the inferior continuation of the lachrymal sac. It is a membranous tube, lining the bony canal of the maxillary bone; it becomes smaller as it descends, and is continuous with the mucous membrane of the nasal fossæ; at its inferior orifice, it is sloped off on the internal side, and generally presents a small fold that resembles a valve, which is frequently extensive enough to close the opening when it is raised.

It is especially important to know the situation of the osseous canal. Commencing immediately behind the osseous border that forms the internal and anterior side of the base of the orbit, its inferior end opens below the upper border of the nasal spongy bone, almost seven lines and a half from the edge of the ascending process. Its length varies from three and a half to six and a half lines, but is generally four and a half; whilst the space between its superior orifice and the floor of the nasal fossæ is from eleven to fifteen lines in extent; the canal then only occupies three-sevenths of this space. Its size, measured at its upper extremity, in all the dry skulls in the *Musée des Hôpitaux*, varies from one and a half to two and a half lines transversely; the antero-posterior diameter is always half a line more, so that the orifice is really oval. The middle portion is constricted and circular. The inferior orifice is funnel-shape, and directed slightly backwards.

In its course this canal generally presents a scarcely observable convexity anteriorly and externally; but its essential direction is oblique from above downwards and from within outwards, following a line which, starting from the upper orifice, would cross the mesial line one inch above the end of the nose, and form by this reunion an angle of from 10° to 12° (Vésigné). The sound used is a silver tube, slightly conical, nearly three inches long, furnished at its largest end

Fig. 15.



Vertical section of the Head and Neck: *a*, probe passed into the frontal sinus by the anterior part of the middle meatus; *b*, probe passing through the lachrymal passages; *c*, probe passed into the sphenoidal sinus through the superior meatus; *d*, opening of the antrum Highmorianum; *e*, left half of the tongue; *f*, thyroid cartilage; *g*, os hyoides; *h*, cricoid cartilage; *i*, ventricle of the larynx; *k*, epiglottis; *l*, inferior spongy bone; *m*, middle spongy bone, held up by a hook; *n*, superior meatus; *o*, Eustachian tube; *p*, middle meatus; *q*, base of the brain and medullary canal; *r*, roof of the mouth and uvula; *s*, genio-hyoideus; *t*, œsophagus; *u*, tentorium cerebelli raised on a hook.

with a plate and ring, open at the other, its diameter not being more than one-quarter or one-third of a line at farthest; four lines and a half from its large end begins its curve, representing a little more than a semicircle of one inch and a quarter diameter (Vésigné). Gensoul imagined the plan of moulding the sound in the canal itself, to obtain a more correct curve. To introduce it, it may be fixed in a handle like a pencil case.

The patient being seated opposite the light, the surgeon standing behind him for the right side, in front for the left, holds the sound by its handle as a pen, and fixes the patient's head with his left hand. He directs the point of the sound on the floor of the nasal fossa and against its external wall, in such a manner that the concavity of the instrument regards the corresponding labial commissure. When

three-fourths of the curve have entered the nostril, he turns the sound on its point, and causes the hand to describe a quarter of a circle, until the handle becomes vertical, opposite the internal angle of the eye. Then the sound has arrived under the inferior spongy bone. Its convex portion rests on the floor of the nasal fossa, whilst its point is on the summit of the inferior meatus. You assure yourself of this by trying to raise the sound with a movement of depression, judging by the resistance you meet with. If you find you have not succeeded, you must recommence this first step of the operation. Then, the orifice of the nasal duct is sought, the sound being moved backwards and forwards until its point is found to be engaged in the canal; that is to say, when it can no longer vacillate. To make it penetrate more

forwards, depress the handle gently and without effort, carrying it towards the lobe of the nose, and bringing it to the opposite side, in the direction of a line which, from the internal angle of the affected eye, would reach the first superior incisor tooth on the sound side. If the passage is free, the sound arrives with great facility at the lachrymal sac; and is recognized there by the touch; then the handle is parallel to the horizon or nearly so, and corresponds to the first incisor tooth. If you intend allowing the sound to remain, unscrew the handle, and pass through the ring a thread, which you may fasten on the cheek with a bit of plaster. The most difficult step of the operation is making the curve. The directions pointed out should be closely followed. In directly depressing the handle, you risk breaking the inferior spongy bone or the walls of the duct. You must then act gently; and if any obstacle opposes itself, move the sound about, or even withdraw it slightly, to introduce it again. Sometimes any extraordinary depression, or the elevation or curvature of the inferior spongy bone, or again, any very marked deviation of the septum nasi, hinders you from finding the inferior orifice. You need only be forewarned of the obstacle to be able to overcome it easily. At the superior orifice also, sometimes the sound is arrested by a little osseous projection, that exists on the external or anterior side, principally in narrow-nosed people. When you have reason to suppose that the point of the instrument is stopped by this projection, to disengage it, slightly raise the handle, and seek to give it a movement of rotation that will direct its point towards the lachrymal canal. It has been said that the little valve at the orifice of the canal might render the introduction of an instrument impossible. Vésigné says he never met with such an obstacle. The sound would be more probably arrested at this orifice by a constriction either of the bony canal or soft parts. This last obstacle might be overcome, unless obliteration was complete.

(2.) *Of Fistula Lachrymalis.*

This affection shows itself, in its first stage, as a prominent tumour at the angle of the eye, formed by an accumulation of fluid in the lachrymal sac. In its second, the tumour is ulcerated—there is really a fistula. In its third, the bones, and particularly the os unguis, are affected and carious. Your attention should be fixed on the fact that in almost all these cases the tumour and fistula arise from a chronic engorgement of the soft walls of the nasal duct; sometimes from acute or chronic inflammation of the lachrymal sac itself. In some rare cases, the canal is blocked up by an exostosis. Such are the principal circumstances that should direct the surgeon in his choice of methods and proceedings.

There is a great number of methods of operation. The principal are: *Compression—dilatation—the permanent stylet—the permanent canula—cauterization—the intimate adhesion of its mucous parietes—and the formation of an artificial canal*, which itself comprises three methods; lastly, obliteration of the lachrymal passages.

I. COMPRESSION is practiced on the tumour itself, by means of

a steel spring terminated by a small cushion and fixed to a metallic spring on the forehead. Its efficacy has been denied without sufficient reason; for we know in the present day how great is the influence of compression on chronic inflammations. But the cushion only acting on the sac, and not on the duct which is the most usually obstructed, we can easily conceive that its success must be very limited.

II. DILATATION OF THE NASAL DUCT.—This is another kind of compression, but more efficacious, as it acts at the same time on the engorgement, which is the cause, and the stricture its effect. The proceedings have varied, particularly according as there is fistula or only lachrymal tumour.

Proceeding of Méjean.—When the tumour is not ulcerated, he advises the introduction by the superior lachrymal punctum of an eyed-probe armed with a thread, which is brought out through the nostril; to the inferior extremity of the thread he attached a seton of progressively increasing size, which is easily drawn into the canal by means of the thread. This proceeding, and all its modifications also, will always have the serious inconvenience of exposing to ulceration and consequent obliteration of the superior lachrymal punctum.

Proceeding of Laforest.—Much preferable to the former. It consists in placing in the nasal canal a full-sized sound, which is left there for some days to clear the passage: it soon becomes movable, when it may be withdrawn and replaced by a hollow instrument, which should remain until the cure is completed, by means of which several times a day appropriate injections may be made. Vésigné has almost always succeeded in carrying a gum-elastic catheter No. 2, with a suitable curve, into the canal, the stylet of which he withdraws without difficulty.

But even this is not gradual dilatation, as it is practiced on the urethra: so that the authors seem to reckon on the injections. What appears to us more rational than this method, would be to leave the silver probe or gum-elastic catheter *in situ* until it became movable; then, to avoid the difficulty of introducing a larger sound, pass into the first a steel wire stylet, which you would leave in the canal, withdrawing the catheter; having done which, you might introduce a larger on the stylet, which would serve as a conductor for it. You might thus successively introduce them, to the size of a line and a half diameter; or you might, after the plan of Cabanis, use the stylet of Méjean to direct the sound of Laforest, if the rules we have given do not suffice.

J. L. Petit incised the tumour to pass into it from above downwards a conical bougie; Lecat a bit of catgut; Scarpa a lead wire; others a gum-elastic bougie or a seton. Pellier, Sen., used, in passing the seton, the following proceeding: He took a small bit of lead resembling the end of a urethral sound for a child seven or eight years old, and a quarter of an inch long; to this he fastened a bit of horse-hair or strong silk, and, after having cleared the passage of the nasal canal with a sound, he placed the bit of lead in it, and pushed it on with the sound, till it fell into the nasal fossa. Then withdrawing the sound, and making the patient lean his head forwards and blow

his nose, the bit of lead fell into the handkerchief, and the hair or silk served as a conductor to draw the seton from below upwards.

Pouteau remarked that these foreign bodies introduced by the wound finished by transforming it into an ulcer with its borders turned in, and leaving in consequence a depressed cicatrix. He made the incision inside the lower lid, between the palpebral edge and the caruncula lachrymalis.

All these proceedings are tedious in their action, excessively disagreeable for the patient, and have not the efficacy of those we are about to describe. When the tumour is ulcerated, it suffices to enlarge the opening for the introduction of the bougies.

III. PERMANENT STYLET. *Proceeding of Ware*.—Ware accidentally observed that when a metallic stylet is placed in the canal, the overflow of tears almost immediately ceases, and concluded that the tears flowed down beside the sound, and on this established his method.

His stylet is a metallic wire about an inch and a quarter long, straight in almost all its extent, but curved at its upper part at an obtuse angle. The inferior end, very long, is intended to occupy the duct; the superior is only two lines long, and terminates by a circular flat head about two lines in diameter. When the stylet is placed, its superior branch rests in the course of the incision made into the lachrymal sac, and its flat head covers and masks the external wound. It is coloured with black varnish to simulate a patch: others colour it like flesh. The patient wears it all his life.

The manner of introducing it is nearly the same as for the canula, and will be described in the following article. This method is much approved of in England and America; but Jameson declared some years ago that he had never seen it entirely dissipate the inconvenience of the fistula.

IV. PERMANENT CANULA.—The idea of placing in the ducts a permanent metallic canula, to obviate new obliterations, is generally ascribed to Foubert. This method having prevailed in our time, in consequence of the successes and authority of Dupuytren, we shall describe it at suitable length.

It is especially important to well recognize the superior orifice of the nasal canal. Its position varies in different subjects, according as the root of the nose is narrow or wide, and the commissure of the eyelids is more or less distant. The tendon of the palpebral muscle itself is not a sure guide, as it is sometimes attached more internally than usual—even as far as the anterior part of the ascending process of the maxillary bone. A fixed guide is afforded by the osseous border which limits the lachrymal groove anteriorly.

To recognize this projection, carry your finger along the inferior edge of the orbit to the internal angle of the eye, where it is stopped by the anterior lip of the lachrymal groove. If you plunge in a bistoury perpendicularly below this edge, you are sure to penetrate into the nasal duct. Three very remarkable varieties of relations here present themselves. Sometimes the finger is stopped, and the puncture should be made outside the palpebral commissure; or it may be

on a level with the commissure, and immediately below it; or lastly, to the inner side of the commissure and below the tendon of the orbicularis muscle. In all these cases, if the eye is very prominent, it must be pushed back to avoid wounding the cheek with the knife. If, on the contrary, the eye is sunk in the orbit, the operation does not present this difficulty.

We have pointed out the oblique direction of the canal downwards and outwards in the direction of a line drawn from the superior orifice across the median line, an inch above the nasal expansions, forming by this crossing an angle of 10° or 12° . We must add that the axis of the canal is differently related with regard to the superciliary arch, and is sometimes in front, sometimes on a level, sometimes behind it, according to the development of the frontal sinus.

Proceeding of Dupuytren.—The instruments necessary are, 1. A gold or silver canula about one inch long, larger above than below, furnished at its upper extremity with a circular lip, slightly bent in its length to suit the shape of the canal, and cut slantingly off at its other end so that its orifice is on the side of the concavity of the curve. To have it of suitable length, Grenier proposed to measure in a straight line the interval that separates the superior orifice of the canal from the superior depression on the ala of the nose; by this you obtain very nearly the approximate length of the canal, and that which should be allowed to the canula. 2. A stylet, a bit of steel wire curved at a right angle; the smaller end of which is fine enough to pass freely in the canula, not quite so long as the canula, and furnished with a ridge to rest on it; the other end, longer, serves as a handle for the surgeon to introduce the canula: but, in addition, it terminates by a male screw which perfectly fits a female screw in the interior of the canula, near its lip, so that it can be solidly held and withdrawn from the canal. 3. A straight narrow bistoury, very pointed. Seat your patient opposite the light, with his head resting on the breast of an assistant, who places one hand on the patient's forehead, and with the other draws outwards the external commissure of the lids, to cause the tendon of the orbicularis to become prominent. The surgeon, seated in front of the patient, holds the bistoury as a pen, in his right hand for either side, only changing its resting place.

You commence by seeking the superior orifice of the canal; if the morbid condition of the parts hinders you from applying the rules we have pointed out, recognize it on the healthy side: place your left index finger in the receding angle formed by the anterior ridge of the lachrymal groove, and the inferior orbital edge, with the pulp of the finger turned backwards, depressing the eye and lid. In front of this finger, behind the osseous projection it exposes, plunge in the bistoury (with its back towards the nose, and its edge outwards), in a vertical direction, so as to engage its blade in the canal; then gently bring the handle of the instrument towards the root of the nose, until it reaches the specified inclination, and continue to push it on till it will not go any further forwards.

This first step finished, you may know that it has been well performed if the instrument will not vacillate in any direction, and if its

point does not raise the soft parts of the cheek. One instant suffices to prove this, and you should not neglect to do it; if unfortunately you have pushed the instrument into the soft parts of the cheek, without completely withdrawing it from the wound, raise it and carry it backwards behind the edge of the orbit, where you must again seek the canal with the necessary precaution.

When sure that you have penetrated into the canal, take the bistoury in your left hand, and gently withdraw the blade upwards, pushing it a little backwards to make the external wound gape. Introduce by this opening along the blade of the bistoury the stylet and canula; when it is in the canal, altogether withdraw the bistoury, and, with moderate pressure, push the stylet until the lip of the canula is concealed in the lachrymal sac, and far enough from the external wound not to hinder its cicatrization; the stylet is then withdrawn. Apply your thumb on the wound, and cause the patient to blow his nose forcibly. If some drops of blood escape by the corresponding nostril, and a little blood mixed with air comes out of the wound, it is a certain sign that the canula is well placed; you need then only put a bit of oiled silk on the little wound, which is often closed in twenty-four hours. If, on the contrary, these appearances do not offer, you have made a false passage, or the canula is not passed deep enough; it must be a little withdrawn and placed more suitably.

This proceeding is admirable for the rapidity of its execution and the promptitude of its results. The patients may at once attend to their business; they are not generally sensible of the presence of the canula. But at the same time, as Dupuytren employed it, this proceeding is subject to many objections.

For instance, the canula sometimes rises under the skin, at others it falls into the nasal fossæ. Delpsch once saw it traverse the roof of the palate. Darcet reports twenty-seven cases where it has been necessary to extract it; mucus or snuff may fill it up, and obliterate it; or the silver become oxidized in the canal; lastly, it causes headaches and local irritations, &c.

I have treated this subject at length in my *Thèse de concours*, on the Treatment of Fistula Lachrymalis.

Part of these accidents are due to the smallness of the canula, its great length, its shape, and the nature of the metal, and also to the operation. I therefore proposed a canula made of gold or platinum, three-quarters of an inch long and one line and a half in diameter, having, like that of Pellier, a superior and middle ridge or collar, without the oval opening at its inferior extremity; at the same time, before placing it in the canal, it seems to me more proper to incise the tumour as a simple abscess, than to overcome or force the constriction and dilate the canal, by the introduction of graduated sounds kept in two or three days, after which the canula is put in.

In this way you run no chance of making a false passage; you do not tear the mucous membrane; and you accustom the canal by degrees to the presence of a foreign body. The form and composition of the canula prevent the occurrence of the other inconveniences.

To extract it, several means have been proposed. The simplest is

the screw and socket of the stylet and canula, or the crochet of J. Cloquet.

We should also add that, even when accidents render this extraction necessary, the patient still remains as advanced as those who have been treated by the methods of dilatation, and that he has had much less inconvenience and pain.

V. CAUTERIZATION.—Having, in 1822, proposed to cauterize the nasal duct through an opening in the lachrymal sac; a proceeding the first indications of which are met with in Heister. A little later, M. Gensoul of Lyon proposed to introduce the *porte-caustique* by the nostril after the method of Laforest. In whatever way you use it, the preference should always be given to a *porte-caustique* like that of Ducamp for the urethra, without the protecting sound. Nothing is easier to conceive than this operation, combining the proceedings of catheterism described above with the precautions that govern the employment of caustics, of which we shall speak more fully in the article on strictures of the urethra.

VI. FORMATION OF AN ARTIFICIAL CANAL is an extreme resource, to which recourse must be had only when the natural canal does not exist, or is obliterated by an exostosis. Then there are three proceedings, according to the directions given to the new canal.

1. *Proceeding of Wathen*.—Wathen proposed to make an artificial passage in the same direction as the natural canal would have taken by means of a piercer, and to keep it open by placing in it a permanent canula. This operation appears to have been once performed by Dupuytren.

2. *Proceeding of Laugier*.—It consists in making an opening of communication between the lachrymal sac and maxillary sinus. Having opened the sac with a bistoury, pass along the side of it a small trocar bent at about half an inch from its point, which is turned downwards, the projection of the angle being upwards and inwards; as soon as it has just entered the upper part of the nasal duct, elevate the handle, and turn the projection of the angle towards the root of the nose, inclining its point towards the external wall of the nasal canal, and cause it to enter the maxillary sinus by a slight effort; turn the trocar about to enlarge the opening, and then withdraw it. As the osseous opening is liable to contract, Laugier thinks that, if this accident is established by experience, we might push in all the wall that separates the nasal canal from the sinus. It seems much more simple to keep up the opening with a double-edged canula, or with a double stud like that which Dupuytren used for ranula.

Proceeding of Woolhouse.—He perforated the os unguis, and placed in the orifice a canula of gold, silver, or lead, one-half to three-quarters of an inch long; but (what most writers have omitted) he first removed all the mucous membrane of the lachrymal sac. This part of the operation has since been rejected.

The means of perforation have been much varied. Woolhouse traversed the os unguis with a piercer. Saint-Yves preferred the actual cautery. Hunter invented a special instrument to remove it bit by

bit. Nicod proposed uniting perforation with the trocar and cauterization.

In order to well appreciate these proceedings, you must recollect that all these osseous perforations perpetually tend to retract and close, and that it is necessary to maintain them open by leaving in them a canula; on which account the two last should be rejected, as they only make a shallow opening that would not contain or retain the canula. As to the proceeding of Wathen, we may say that he attempts an impossibility. Supposing the canal to be obstructed by an osseous column that occupies its entire thickness, how hope that the drill or gimlet will not deviate to either side, especially as there is no resistance at the side of the canal? If the canal is destroyed, on the contrary, by the approximation of its parietes, as takes place in alveoli that are empty, how hollow out another in the same direction when these parietes are wanting? Again, if the canal is simply obliterated by adhesion of its mucous linings, what use is a gimlet to pierce the soft parts? Lastly, in no case can there be a certainty that the instrument will not go astray. Some years ago, I met with a case of obliteration of the canal in a boy twelve years of age; at least after having laid bare the lachrymal sac by a large incision, neither I nor my assistants could find the least trace of the duct. I conceived and immediately put in practice the following proceeding.

New Proceeding.—I pushed, in what I thought the nearest to the direction of the canal, the stylet of the canula, which is pointed enough to easily penetrate. When the instrument had reached the nasal fossæ, which was recognized by some drops of blood flowing from the nostril, and the sensation experienced by the patient, I withdrew it, and pushed forcibly a double-rimmed canula into the hole it had made. The operation is very simple, and is terminated in a few seconds.

VII. OBLITERATION OF THE LACHRYMAL PASSAGES.—Either you destroy the lachrymal sac or obliterate the puncta.

Proceeding of Nannoni.—He opened the sac with a bistoury, filled it with soft lint, and, when the pain was passed off, destroyed it with a caustic composed of alum and precipitate. His son, L. Nannoni, had recourse in obstinate cases to the actual cautery.

Proceeding of Bosche.—He recommends simply cauterizing the puncta with a very fine pencil of argent. nit. These two proceedings are doubtless the last resources of the surgeon; but when the obstinacy of the disease forces you to it, there is no doubt that the last is to be preferred.

Appreciation.—This multiplicity of methods and proceedings seems to testify to the richness and resources of the art, but really only proves its poverty. More complete experiments and experience have caused the success of the canula to be much doubted, even in cases where it succeeded best at first. I, in the case mentioned above, saw most complete success give place, after four months, to a relapse, without the canula being displaced. The inconvenience became so great, that I was forced to withdraw the canula, making a new incision at the lachrymal angle. The canula was made of platinum, and was nowise injured; it only contained a little semi-concrete mucus.

Sichel has already collected a considerable number of analogous cases; and these unexpected relapses should cause the surgeon to be very circumspect in his prognosis. Meditating on this subject, I came to the conclusion that a stylet like Ware's, the round head of which might be buried in the sac, would perfectly attain our object without leaving a permanent fistula on the exterior.

This in fact was the method I last tried on my young patient. The fistula closed, and the cure was complete. But lately he has returned to show me a slight sinus on a level with the sac, which now and then opens and closes; and to complain of a similarly intermittent flow of tears. In addition, several large ganglia came on the corresponding side of the jaw, though the constitution is not at all scrofulous; and I do not yet know to what to have recourse.

(3.) *Obliteration of the Lachrymal Ducts.*

Heister only regards as curable the obliteration caused by a small pellicle at the opening of the puncta. He advises piercing this pellicle with a needle, and introducing from time to time a silver wire or a bristle, to keep open the passage.

J. L. Petit first successfully treated a case of complete obliteration of the canals by passing into the inferior passage a very thin gold wire, which he left in for some time; and though the upper canal was closed, the patient recovered from the involuntary overflow of tears. You may in similar circumstances make the artificial canal by traversing the lid from without inwards; or as Monro wished, incise the sac and perforate the tissues from within outwards with a needle.

G. Pellier followed the first method, and succeeded in maintaining the passage open by means of simple injections. It would be perhaps preferable to pass the needle from within outwards, but without incision, using the nasal sound armed with a spear-point invented by Manec to facilitate the passage of the seton.

(4.) *Extirpation of the Lachrymal Gland.*

The lachrymal gland, when scirrhus, may require extirpation. In addition to the general rules for dissections, there are here two operative proceedings.

Proceeding of Acrel.—Divide all the thickness of the eyelids parallel to their folds, and on the most projecting point of the tumour; the latter being laid bare, seize it with a forceps, and dissect it out, commencing at the side that faces the eye, in order to avoid it more surely.

Proceeding of Velpeau.—Prolong the external commissure towards the temple by means of an horizontal incision. In this way, you very easily expose the two external thirds of the orbital circumference. You then reach the tumour either by dividing the cellular tissue touched in the first incision, or circumscribing it by a semi-lunar incision at the side of the cornea. In these operations, the tissues being torn rather than incised, suppuration must be expected, and a mèche of lint should be left in the wound.

SECTION II.—OPERATIONS ON THE LIDS.

(1.) *Of Ectropion.*

Ectropion arises from two different causes—either the conjunctiva is swollen and tumefied, or the external skin is contracted by a cicatrix.

In the first case, you may cauterize the conjunctiva with the nitrate of silver, or simply apply drying and resolute collyria; in case of failure, you can have recourse to partial excision of this membrane. In the second case are employed excision of the conjunctiva, excision of the tarsal cartilage, V-shaped excision of the lid, tarsoraphy, blepharoplasty; and, lastly, the method of Dieffenbach.

I. **EXCISION OF THE CONJUNCTIVA.**—The patient being seated, with his head inclined backwards, the surgeon seizes the everted lid with the finger and thumb of the left hand, causes the conjunctiva to project out as much as possible, and with curved or flat scissors completely removes the fungous portion, carefully directing his incision parallelly to the free border of the lid.

If the conjunctiva cannot be easily enclosed by the scissors, seize it with a forceps or double hook, raise it as much as possible, and incise it with a scalpel as deep as is necessary along the tarsal cartilage, avoiding the lachrymal puncta; then raise with a forceps the upper flap to be removed, and cut it off with the knife from the internal surface of the lid, as far as the point, when the conjunctiva passes on the globe of the eye; then resect the flap at its base with a scissors. The ancients cut a V-shaped flap from the entire thickness of the lid, the skin excepted, and reunited the two edges of the V near the free edge of the lid, by a point of suture.

II. **EXCISION OF THE TARSAI CARTILAGE** (*Weller*).—In ectropion of long standing, Weller has remarked that there comes on an actual elongation of the palpebral edge of the tarsal cartilage, which he attributes to the distension of the interpalpebral ligaments. After ordinary incision of the conjunctiva with a bistoury, he resects from the middle of the lid a portion of the tarsal cartilage about two lines long, taking care not to wound the external edge of the border of the lid. Cure has been followed in every case; there only remains a slight gap in the border of the lid where it was cut.

III. **V-SHAPED EXCISION OF THE LID** (*W. Adams*).—Cut with a straight scissors a V flap, from the entire thickness of the lid, three lines from the external commissure; the base of the V is at the free edge of the lid, its summit is towards the globe of the eye; the sides are usually six lines in length, their lengths depending on the extent of the ectropion; the two edges are then united by the interrupted suture (*Adams*), twisted suture (*Roux*). *Traverse*, *Guthrie*, *Dieffenbach* *Roux*, and *Velpeau*, have successfully performed this operation. The base of the flap should not be more than a quarter of an inch wide; *Velpeau* thinks it useless to prolong the extent of it beyond the tarsal cartilage.

IV. TARSORAPHY (*Walther*).—A proceeding that cannot be applied generally. An individual had in the left temple a cicatrix, with loss of substance, which drew outwards the palpebral commissure, and gave it a rounded irregular form; the eyelids were curved outwards and the conjunctiva inflamed. Walther circumscribed the cicatrix by two incisions, united towards the temple, and which comprised the external third of the tarsal cartilage of each lid; two points of suture reunited the wound, and the double ectropion was completely cured.

V. BLEPHAROPLASTY (*Graefe*).—Place the patient as usual (opposite the light), circumscribe the cicatrix between two incisions, and remove it by dissection. The first incision should be made parallelly to the tarsal cartilage, if possible some lines distant from it, so as to leave enough skin to fix the flap to. The cicatrix removed or destroyed, separate the edges of the wound, so as to give to the lid its natural length, an indispensable condition; to effect which, you may even divide the orbicularis muscle down to the conjunctiva.

This first step finished, proceed to the formation of your flap; for the upper lid it is cut at the expense of that part of the skin of the forehead which is on its outside, about two lines above the border of the orbit. It is measured by the wound, but you should always make it one line wider, and longer than the wound; it should be cut so that the upper part become the internal part of the new lid; its internal edge should be continuous with the external edge of the wound of the lid, so that after its dissection it may be easily united to the inferior border of the wound; and its external edge should be prolonged by the incision, so far downwards and outwards as to fit the upper border of the palpebral wound. This incision should allow the flap to cover the wound without the skin being twisted or strained, if it does not prolong it a little further outwards.

Dissect off the flap thus circumscribed, and apply it on the wound, cutting any band or slips of integument that oppose its exact co-adaptation. Stop the bleeding by the application of cold water, and, when it has completely ceased, unite by interrupted suture. The points of suture should not be too few; for a complete lid you always need eight or ten at the upper border, and six or eight at the inferior. For the inferior lid cut the flap downwards from the malar region, on the external side of the lid, at the same distance from the edge of the orbit, and according to the principles we have just laid down.

After forty-eight hours, the threads should be removed, and adhesive straps put in their place. The cure is complete in from ten to eighteen days. When the conjunctiva is much hardened and diseased, and you do not think it right to remove it before the operation, it is necessary to do it afterwards by the proceeding described.

VI. METHOD OF DIEFFENBACH.—We shall describe it as if you were about to operate on the lower lid. Commence with a narrow straight bistoury, by making some lines below the inferior edge of the orbit, and, parallel to this edge, a semilunar incision, as long as two-thirds of the lid, and occupying exactly the middle of it. This incision can always be made from right to left, and with the right hand, starting below the internal commissure for the left eye, the external

for the right. When the incision has completely divided the skin, detach it inferiorly from the tarsal cartilage to a certain extent, and in the point where you stop this dissection, divide the orbicularis muscle, and conjunctiva, parallelly to the cutaneous incision, and to the same extent; then with a forceps draw the upper edge of the wound of the conjunctiva, with the tarsal cartilage that adheres to it, into the wound of the teguments; and after having cut off a small portion of the conjunctiva, bring together the lips of the external wound, having between them the conjunctiva and tarsal cartilage; reunion should be made with small pins and the twisted suture; after which, bend up the ends of the pins, and cut them off near the threads. Put cold applications to the affected eye, and, if necessary, have recourse to antiphlogistic measures. The pins may be removed from the third to the sixteenth day. The small bit of the conjunctiva is excised as much to refresh the surfaces and facilitate reunion as to leave nothing to pass the common level of the integuments.

The operation is the same for the upper lid.

(2.) *Blepharoptosis, or fall of the Upper Lid.*

Blepharoptosis may arise from two principal causes; either from a considerable prolongation of the skin of the lid, with diminution of the contractility of the levator muscle, or from a complete and irremediable paralysis of that muscle.

For the first case, cauterization by hot iron, sulphuric acid, &c., have been tried—for the purpose of causing the skin to shrink. It is better to remove the superfluous portion of relaxed integument.

Ordinary Proceeding.—With a common forceps, or the fingers, seize a transverse fold of the integument large enough at its base to enable the patient to open and shut his eye with facility, and excise it at one stroke with scissors curved on their flat. A little more should be removed rather than too little. Stop the hemorrhage, and unite by two points of suture, which you may take out after twelve hours (Langenbeck); at latest, after seventeen or eighteen hours (Weller). If you leave the threads longer, the points suppurate, and the lids often swell. Scarpa does not make any suture at all; and I have found that cicatrization is not any longer in taking place without them, only I take care to depress the eyebrow by means of a circular bandage and compress. When there is absolute loss of action in the levator muscle, Hunt of Manchester, after Morand and Acrel, advises replacing it by the occipito-frontalis, which in fact assists in opening the lids by raising the skin of the eyebrows. Moreover, there is so much accordance between these two muscles, that it is almost impossible to raise the brow whilst the eye is firmly shut, or to depress the brow whilst the eye is widely open.

Proceeding of Hunt.—He makes a semi-elliptical incision with its convexity upwards immediately below the arched line of the eyebrow, and extends it on each side to opposite the commissure of the lids; an inferior incision joins the two ends of the first, and circumscribes a flap of skin, which is removed. He brings the wound together immediately by three points of suture. When cicatrization is accom-

plished, the skin of the lid is united with intermediate folds to the skin of the brow; which being elevated by the action of the occipitofrontalis, necessarily draws the lid with it. The inferior incision should be more or less close to the free border of the lid, according to the degree of relaxation. The removal of the flap does not cause any deformity.

(3.) *Of Entropion, or Inversion of the Lids.*

Entropion is only serious on account of the inversion of the eyelashes, which causes a continual irritation of the conjunctiva. The object is to draw them outwards, or destroy them. Numerous means have been advised.

I. ADHESIVE STRAPS.—Demours declares that he cured in twenty days cases of entropion depending on an extreme laxity of the skin, and following œdema of the cellular tissue. He raised the lid by means of two or three strips of adhesive plaster. Velpeau succeeded in the same way on a case where excision had failed.

II. CAUSTICS. *Proceeding of Quadri*.—After having carefully wiped the lids, and adapted an adhesive strap so as to hinder the caustic from entering the eye, he extended on the lids, by means of a bit of wood, a drop of concentrated sulphuric acid, enough to cover an oval surface of about a quarter of an inch, and rather longer than the line of the inverted lashes. After about ten seconds, he carefully wiped the lid, and applied a second drop on the same spot, extending it a little farther than the first, then wiped it again. If then, in consequence of the retraction of the skin of the lid, the lashes turn outwards, he ties them in three or four bundles by means of silk threads, fixed to the forehead to keep the lid properly elevated. If, on the contrary, the lashes do not move after the second cauterization, use a third or even a fourth.

Weller remarks that the lashes become disengaged from the silk on the least movement. It seems to me much more sure and simple to maintain them raised against the external surface of the lid by means of a little pitch or glue.

The red-hot iron has been also used. We have given the general rules for its employment. It should be applied very lightly here, not to extend the effects of the cauterization to the eye itself. Ware says he succeeded by touching with the red-hot iron the elevator muscle previously laid bare.

III. EXCISION OF THE SKIN.—Several proceedings have been advised. The best is the one we have described for blepharoptosis.

IV. EXCISION OF THE TARSALE CARTILAGE. *Proceeding of Saunders*.—After having introduced between the lid and globe of the eye a thin plate of horn or silver, on which to extend the affected lid, incise the integuments and orbicularis muscle in the direction of the tarsal cartilage immediately above the roots of the lashes; then cautiously dissect the external surface of this cartilage until its orbital edge is laid bare. Separate it from the conjunctiva behind; and, lastly, detach it on all sides, taking care not to injure the lachrymal punctum. This proceeding is founded on the anatomical fact that the levator

palpebræ being inserted into the integuments and conjunctiva, the removal of the cartilage does not take away its attachments. Cicatrization is rapid. But Saunders always saw a considerable fungus become developed on the external wound, which he easily destroyed by caustic, or, better still, with the bistoury.

Proceeding of Guthrie.—Introduce the blade of a small blunt bistoury, or the blunt blade of a pair of scissors, into the external angle of the eye, and make a perpendicular incision in the lid, comprising its entire thickness, and from a quarter to half an inch long. Another incision of the same extent is made at the internal angle outside the lachrymal punctum. These two incisions should be prolonged in such a manner that the portion of the lid which contains the tarsal cartilage may be free, and not obey the action of the orbicularis muscle. Then entirely reverse it on the forehead, where the operator keeps it with his left index finger, whilst he finishes cutting the adhesions that still leave it controlled by this muscle, if any exist. Then let it fall again, and make the patient naturally raise the lid. If you perceive that the tarsal cartilage retains an abnormal curve in its movement, remove by a transverse incision a portion of the skin comprised between the two incisions, and excise a sufficient portion of this cartilage to destroy its curve. It is especially near the internal angle that this curvature is remarked, and consequently there the excision should be most considerable. Then pass through the edges of the transverse wound four ligatures, the ends of which collected are brought on the forehead, and there fastened by adhesive strapping, to hinder the detached portion of the lid from uniting as before. Guthrie passes the ligature placed near the internal commissure quite through the lid.

V. DESTRUCTION OF THE CILIARY BULBS.—The preceding methods are for the purpose of correcting the mal-position of the lashes; these for destroying them and preventing their reproduction. Cauterization and the bistoury are employed.

Proceeding of Champesme.—Commence by extracting the deviating lashes with a forceps, then, reversing the lid outwards, and carefully shielding the globe of the eye, cauterize each particular bulb by means of an actual cautery, with a globular expansion sufficiently large to retain the heat required for the operation, and terminating in a point some lines in length.*

Proceeding of Vacca Berlinghieri.—Commence by tracing with ink, on the skin of the lid, a line which exactly indicates to what extent the lashes deviate from their normal direction. A plate of horn or metal is passed between the eye and lid, to sustain one and shield the other; the surgeon then makes two vertical incisions, which commence one line and a half from the edge of the lid, and terminate in it; then he unites them by a transverse incision, which, like the two first, only divides the skin. He seizes the flap, made by these three incisions, with a forceps, and dissects it in such a way as to lay bare the bulbs of the lashes, situated near each other immediately under the skin;

* A very finely-pointed probe dipped in melted nitrate of silver may be more conveniently used.—F.

the lashes should be removed one by one, or, if the blood prevents your distinguishing them, detach and remove the cellular tissue in which they are embedded. You might also use a wooden tooth-pick, covered with cotton dipped in nitric acid, to cauterize the bulbs separately.

VI. EXCISION OF THE EDGE OF THE LID. *Schréger*.—The affected border being seized and everted, the operation, which is very simple, consists in cutting off with a curved scissors a semi-elliptical flap, comprising all the diseased portion with the lashes it contains.

Appreciation.—We have passed over in silence the extraction of the lashes extolled by Beer. It is said that there has been some success obtained from it; but it is too evident that they will almost inevitably re-appear, and that this method promises but a temporary cure.

In respect to the other proceedings, it may be seen that most may be serviceable, according to the different degrees of the disease; thus, after bandages, cauterization, or excision of the skin, we have excision of the tarsal cartilage, which, in case of success, leaves less deformity than the destruction of the bulbs, and complete loss of the lashes; the excision of the edge of the lid leaves a loss of substance as well as of the lashes, and it is the last means to which we should have recourse.

(4.) *Of Trichiasis.*

Trichiasis is only the retroversion of one or more lashes; the indications are the same as for ectropion, but modified by the extent of the disease; besides the methods we have described, you might also successfully use an excision of the lid or cartilage, when the small number of deviating lashes allows you to include them all in the one flap.

(5.) *Viscous Adhesions of the Lid.*

The union of the lids to each other may be congenital or accidental; it is treated according to the rules laid down for abnormal obliterations. If union is complete, first a small opening is made near the temple, by which a director is introduced, on which a bistoury is passed, cutting from within outwards. If it is incomplete, introduce the director without previous incision.

The difficulty is to hinder subsequent re-adhesion; the autoplasmic method of Dieffenbach cannot be put in execution; there remains that of Serres, of Boyer, or of Rudtorffer; but we must add a proceeding of Duddell, which consists in dividing the adhesion by means of a metallic wire, and which perhaps does not deserve the abuse M. Velpeau gives it. We must confess we do not know of a single successful case obtained by any means. The method of Amussat, to prevent re-establishment of diseased cicatrices, allows us to indulge better hopes for the future; but it has not yet been applied to an actual case.

(6.) *Tumours of the Lids.*

These tumours are of three kinds, *encysted*, *cellular*, and *cancerous*.

1. ENCYSTED TUMOURS are treated by excision alone or with cauterization.

Excision is performed in two ways. Sometimes the tumour is dis-

sected from the exterior; the lid is then extended with the fingers of the left hand, a transverse incision made one-third longer than the greatest diameter of the tumour, and the cyst removed by dissection or enucleation. Light and small instruments should be used, and care be taken not to traverse the lid or open the cyst before it is entirely dissected. Generally we prefer attacking the tumour by the internal surface of the lid, to avoid a cicatrix; the lid must be previously turned inside out. The best method of effecting this consists in seizing it by the lashes and border of the tarsal cartilage, and turning it over on a sound, placed horizontally above the cartilage; the transverse incision is made, and the tumour, raised with a hook, is dissected out, care being taken not to open it.

Cauterization is preferred by Dupuytren. The lid being turned inside out, incise the conjunctiva and cyst both at once; empty the latter, and cauterize its entire surface with a pencil of argent. nit.; the cyst exfoliates, and the wound heals rapidly.

II. CELLULAR TUMOURS.—Lisfranc found that many tumours, confounded with these cysts, were the result of an hypertrophy of the cellular tissue, generally following a sty that had not suppurated. In many cases a fistulous passage, starting from the centre of the tumour, opens on the conjunctiva, principally towards the internal edge of the tarsal cartilage; without doubt it is in tumours of this kind that dissolvents and acupuncture have been successful (Demours), a needle fixed across them as a seton (Jacquemin), &c. Lisfranc obtains great success from cauterization of the fistulous passage, with a very pointed pencil of nitrate of silver.

Carron of Villards has modified this proceeding. He explores the fistulous passage with the stylet of Méjean, the lid being previously turned inside out. If the orifice is narrower than the passage, dilate it with the bistoury, then carry to the bottom of the wound a platinum director, very finely pointed, and charged with nitrate of silver like a "porte-caustique." Withdraw it after a minute, and wash the eye with cold water. The tumour inflames, suppurates, and ultimately resolves. When one cauterization is not enough, repeat it.

III. CANCEROUS TUMOURS.—Excision only is employed here, and rather with the scissors than bistoury. Sometimes the tumour is circumscribed in a V flap, the edges of which are united by twisted suture; but if it is wide and extensive, a semilunar bit, containing it, is cut out of the lid.

SECTION III.—OF OPERATIONS PERFORMED ON THE MUSCLES OF THE EYE.

These operations, practiced at first for strabismus only, have since been applied in the treatment of shortness of sight (*myopie*), and certain kinds of amaurosis. Proposed in 1838 by Stromeyer; put in execution in 1839, by several surgeons; to Dieffenbach they owe their generalization and triumph. After Dieffenbach, almost every surgeon took them in hand; and if we except lithotomy, there is no operation on which there have been so many memoirs and special treatises written, or for which there are so many proceedings. I shall confine

myself here, as elsewhere, to the relation of the most important, and those which seem to me to be worth performing.

(1.) *Section of the Rectus Internus Muscle.*

Surgical Anatomy.—This muscle passes along the internal surface of the globe of the eye, and is inserted into the sclerotic three lines and a half from the circumference of the cornea (J. Guerin). This relation is of importance in fixing the spot for incision of the conjunctiva; but, with regard to the layers to be traversed, it is important to know that under the conjunctiva is a fibrous membrane, forgotten by modern anatomists, but pointed out incompletely by Tenon; after whom I was the first to demonstrate it in lecture, and I described it in my *Surgical Anatomy*. Since then a host of surgeons have discovered it, who might have easily found it in my book. It is a white elastic membrane lining the ocular conjunctiva throughout; confounded towards the base of the orbit with the palpebral ligament, and periosteum; in front going as far as the cornea, and then turning backwards to form a complete envelop for the sclerotic, until it reaches the optic nerve, with the neurilemma of which it appears to become continuous. On the sclerotic it is very movable, and a layer of sero-cellular tissue is interposed between them. At the points of insertion of the tendons into the globe of the eye, it is not at all interrupted, but folds round these tendons so as to form a sort of fibrous sheath, which degenerates into cellular tissue on the fleshy fibres. This is the most exact idea you can form of the membrane, which I called *albuginea*, a denomination which, as you can well suppose, did not suit the modern discoverers. Some of these called it the *fibrous capsule of the eye*, others the *sub-conjunctival fascia*. The part covering the conjunctiva has been called the *first layer*, that covering the sclerotic the *second*, and M. J. Guerin has given the special name of "*toge musculaire*" to the spot where the fibrous sheaths, being reflected on the muscles, leave a small free space between the sclerotic and tendons, where they do not follow the tendons. To resume the application of these anatomical relations—you see that you cannot reach the muscle without having divided the conjunctiva, its fibrous lining, and the anterior portion of the muscular sheath; that, if you cut the tendon very near the sclerotic, you only divide the anterior portion of the sheath; and that, to divide it entirely, the instrument must be carried farther back on the fleshy body of the muscle.

There are two general methods: incision of the conjunctiva, and puncture. This latter has also received the name of sub-conjunctival.

METHOD BY INCISION. *Proceeding of Phillips.*—The instruments necessary are—an elevator and depressor of the lids, two small simple hooks, scissors curved on the flat side, a blunt hook to raise the muscle, and closed forceps holding bits of sponge with which to stanch the blood.

The patient being seated in a good light, an assistant standing behind him takes charge of his head, and raises the upper lid; another, standing in front, depresses the lower lid. There should be a third

assistant to hold one of the hooks, and a fourth to hand the instruments; but you can if necessary dispense with the fourth, and even the third, as the assistant who raises the upper lid can also hold a hook; and you will be more sure of your instruments by placing them in your waistcoat pocket.

The operator commences by applying the elevator and depressor of the lids, slipping them under the conjunctiva. When they are properly placed, he confides them to two assistants. He then tells the patient to turn the eye outwards, shutting his sound eye to facilitate this movement, and implants one of the hooks into the conjunctiva some lines from the caruncula lachrymalis. If the eye remains convulsively turned inwards, which often happens, the operator should slip the hook flatly on the globe, and, after passing it back far enough, turn the point in, and fasten it so as to seize the eye, and draw it outwards. This first hook is confided to an assistant; the surgeon puts in a second about a line and a half from the cornea, holding it himself in his left hand. It is well to observe that the point of each hook should be pushed in from above downwards, so that when the two are raised together a transverse fold may be formed in the conjunctiva. The operator then takes the scissors and divides this fold by a vertical section. The hooks being drawn apart, there results a kind of sac formed by the raising of the mucous and albugineous membranes, at the bottom of which you distinguish the sclerotic, with a sort of white band that depresses it from before backwards, and which is the tendon of the muscle. The opening of the sac may be enlarged at pleasure with a scissors. With the same instrument rapidly dissect the cellular tissue and fibrous layers that cover the muscle, so as to fully uncover its fleshy fibres. Then take the blunt hook, and pass it from above downwards between the muscle and sclerotic; and when the muscle is well raised, the operator withdraws the hook he held in his left hand, and takes the blunt hook in its place. The muscle thus raised is dissected free on all sides, so as not to leave any fibrous bands to bind it to the sclerotic. To make sure of its complete isolation, pass the closed scissors between it and the sclerotic, and then cut it across as near that membrane as possible. In general, the eye turns immediately to the centre of the lids; with a last cut of the scissors remove the projection of the tendon left on the sclerotic; wash the eye with a little cold water, and the operation is finished. The patient's eye should be opened, some time after, to see if it has taken the proper direction. The persistence of the strabismus renders it necessary to re-introduce the blunt hook on the muscle or fibrous sheath, to see that there has not been any band or fibres forgotten; and, if there has, to divide them.

Proceeding of L. Boyer.—The instruments are the same as for the last, with the exception of the sharp hooks, which are here replaced by forceps with teeth; and, moreover, the operator wants a dissecting forceps.

Begin by making the patient open his eye and look outwards, and then seize the mucous membrane at an equal distance from the cornea and caruncula lachrymalis with a forceps; then put in the elevator

and depressor of the lids. The eye being thus widely opened, apply the second forceps to make the transverse fold in the conjunctiva. These two forceps are confided to an assistant in whom you have confidence, as you may say the result of the operation is in his hands. The surgeon then incises the fold between the two forceps with a scissors. The assistant immediately lets go the internal flap of the fold of the conjunctiva, and with the forceps now at liberty, seizes the ocular insertion of the muscle which more firmly fixes the globe of the eye, and allows you to withdraw the second forceps. This much finished, the surgeon seizes with his forceps the layer of cellular tissue subjacent to the conjunctiva, makes a small opening in it with the scissors, either above or below the muscle, and passes the blunt hook through it, assuring himself by moving it above that the muscle is entirely taken up; and, having isolated it, he cuts it across with the scissors. It often happens that the muscle is not quite cut across, which may be presumed by the persistence of the strabismus. In this case, put in the blunt hook again. M. Boyer advises detaching above and below, more or less, according to the intensity of the strabismus, the expansions of the cellular tunic of the muscle which affect the neighbouring muscles; in other terms, the capsule furnished by the albuginea to the sclerotic; lastly, terminate the operation by cutting off the ends of the muscle and mucous membrane that come out of the wound.

For separating the muscle from the sclerotic during the section with the scissors, Boyer prefers using a double hook, which, after having been introduced with its branches in apposition, allows them to be spread apart by a kind of spring, and permits the scissors to act between them.

We must now point out the ordinary results of the operation performed by this first method. When the strabismus is not well marked, the wound of the conjunctiva is small, and only requires four or five days to heal. If the eye is much drawn inwards, the wound is very large, and the globe is dissected in half its extent; the flow of blood is then abundant, and the consecutive inflammation comes on so violently as to require energetic opposition. In ordinary cases, on the contrary, it suffices to close the lids with a small band of diachylum, and to apply cold compresses. The patient is not even obliged to keep his bed. After the first three or four days, especially when the wound is large, white granulations spring from the bottom of the wound, which increase rapidly. Sometimes they remain separated; but oftener unite into a large rounded growth, smooth and polished, and end by offering the opal tint and form of a pearl. At last it narrows at its base, strangled by the progress of cicatrization, and is attached to the wound by a small short pedicle. This is the moment for destroying it. Cauterization has been tried, but it is long and painful, and leaves a denser cicatrix. Extirpation is better. Seat the patient, and open the lids as usual. The operator then pushes through the growth a fine hook, passes behind it the blade of a small curved scissors, and removes it in one cut. Scarcely one drop of blood flows. We must warn you in this little operation not to draw too much upon

the hook. The least traction tears the tissue of the excrescence, which is so soft that a pair of forceps, instead of holding, would cut it. Generally, when once cut off, it does not return; nevertheless, when the inflammation has been violent, it is apt to return twice or three times, and must be removed as it reappears.

When the cicatrix is perfect, it is often observed, especially if the conjunctiva has been extensively opened, that the eye projects abnormally forwards; and we shall describe hereafter a little operation for the removal of this projection. The inflammations, formation of fungous granulations, and the consequent prominence of the eyeball, are the three grand reproaches made to the method by incision. Boyer tried to escape the last by incising the conjunctiva horizontally, which would render the operation less sure and more difficult. Guérin obviates these three inconveniences by the following proceeding.

SUBCONJUNCTIVAL METHOD.—The instruments necessary are, two retractors (*refouleurs*) for the lids, which are nothing more than an elevator and depressor; three double hooks; a perforator of the conjunctiva, which is an instrument lance-pointed and double-edged, slightly curved on the flat of the blade, about seven lines long and two across in its broadest part; a “myotome,” with a convex edge and concave back, at an angle with its bent handle, representing a bayonet, the sharp portion of which corresponds to the blade of the myotome.

The patient is laid, with his head resting on a hardish pillow, slightly thrown back, and turned so as to present the affected eye to the light. The assistant whose duty it is to hold away the upper lid, stands at the head of the bed; the other at the same side as the eye to be operated on. Instead of passing the retractors under the lids, Guérin prefers in each case applying them on the cutaneous surface, as near as possible to their free border, and thus retracting them without touching the mucous membrane. He recommends also placing the internal borders of the retractors close to the lachrymal puncta, to avoid bringing the palpebral commissure in front of the eye, and masking the part to be operated on. Affairs being thus arranged, the operator plants a hook in the conjunctiva near the cornea, to draw the eye outwards; this first hook is only to fix the eye, and facilitate the fixing of the second in a well-determined part of the sclerotic, viz., about three lines from the edge of the cornea in the course of the muscle, traversing at once the sclerotic and mucous membranes. The first hook is then withdrawn, and direct traction made with the other from behind forwards, strong enough to stretch the muscle between its two attachments, and detach it as much as possible from the globe of the eye, to facilitate the passage of the myotome between the body of the muscle and the sclerotic. An assistant fixes the third hook about two lines and a half inside the preceding, and not exactly on the same plane, but two or three lines above it on the left eye, below it on the right. It is destined to raise the conjunctiva with its fibrous lining on a level with the lateral wall of the muscular sheath, and the fold thus formed should present its base at the point where the puncture is made. The surgeon then plunges in his perforator at the base of the fold, its convexity turned towards the eye, directing it as a tangent to

the globe in a line intermediate between the horizontal and vertical, so as to certainly traverse the two layers of the fascia, which is known by the sensation of resistance overcome. When you are sure of having pierced the two layers, cause the point of the instrument to describe a slight movement of lateral deviation each way, to destroy the corresponding septum of the muscular sheath, and thus enlarge the subconjunctival space in which the myotome is to act. After this first step, introduce the curved myotome; the instrument is held between the thumb and two first fingers, as in making the vertical puncture, the edge outwards and the back of the blade corresponding to the border of the muscles to be divided. In this position, the first bend of the instrument (that of the blade with the shank) corresponds to the globe of the eye, and the second to the border of the orbit. When the blade has in this manner penetrated vertically to three-fourths of its length, make it describe a little movement of deviation outside the muscle, so as to carry its extremity some distance from the edge of the latter. Then glide the instrument under the muscle two lines from the external wound, which is done by depressing the handle of the instrument, and at the same time slightly carrying the end of the blade towards the globe of the eye. This last movement is indispensable, to avoid passing in front of the muscle or between its fibres. Assure yourself that the muscle is entirely raised on the instrument, by causing the blade to glide in little movements over the globe of the eye in a vertical direction; and, lastly, the blade being thus completely depressed, and in immediate contact with the sclerotic, cause the handle to revolve on its axis, which presents the edge to the muscle; then by sawing movements its division is immediately effected, which is almost always announced by a cracking noise and the sensation of resistance overcome. A very important precaution consists in at this moment drawing on the hook implanted in the sclerotic, so as to tighten and put on the stretch the parts to be cut. The least relaxation of the tissue spoils the action of the instrument. In all cases, to assure yourself that the section is complete, pass the blade of the myotome again through its course. If there remain any fibres or bridles undivided, they are thus immediately cut. The instrument is then withdrawn; and Guérin gives, as proof that the obstacles have been removed, the deviation of the eye to the opposite side, and the impossibility of bringing it to the side operated on. Nevertheless, he remarks himself that, how complete soever the section of the muscles and fascia, the movement of adduction is never entirely abolished, which is very well accounted for by the action of the internal fibres of the rectus superior and inferior. Consequently, if this movement is too considerable, and with signs showing the persistence of the action of the muscle, we would have divided, there should be no hesitation about the re-introduction of the myotome.

Appreciation.—The grand comparison is between the subconjunctival and ordinary method; and it is evident that the former would be always preferable if you were as sure of gaining your end by it as by the second. But the operation is more difficult: it exposes an unpracticed hand much more to wound the sclerotic, and does not in

difficult cases permit of our ascertaining that the muscle has been entirely divided. Guérin himself recognizes the necessity, in certain cases, of re-introducing the instrument. But if after two or three trials the strabismus still continues, how are we to know that it does not arise from an incomplete section, or any other cause? I have seen, and so have most operators, cases in which the strabismus persisted after very complete section of the muscle, and only yielded several days afterwards. There are other cases where, the section of the rectus internus not sufficing, we have to make more extensive divisions. I dissected an eye in which, after section of the rectus internus, I could not with the hook even draw the eye outwards—the superior and inferior rectus had been so much drawn inwards by the retraction of the internal. The ordinary method has then this advantage—that you can assure yourself by your eyes that the section is complete and perfect; and this explains why it is so generally preferred. We should also say that the accidents of the ordinary method—inflammation, projection of the eye, the fleshy growths, &c.—only show themselves in serious cases, and where the conjunctiva has been necessarily largely wounded; and that these serious cases are exactly those in which it is necessary to be well assured of the section of the entire muscle. In slight cases, which allow the eye to return to its place immediately the muscle is cut, the method by puncture has only the difficulty and dangers of the proceeding against it; but the ordinary method has also only need of a small incision, which does not incur inflammation of the eye, or its consequent projection; and the inconvenience of a little excrescence to extirpate is a slight thing in comparison to the immense advantage of following the instrument with your eye, and being sure of what you do.

It remains to compare the two proceedings described, which pretty well include all the others. In the first place, is it better to seize the conjunctiva with the hook before placing the retractors? Boyer has remarked that when you place these instruments before seizing the conjunctiva, the eye is immediately convulsively turned about, so as to render it very difficult afterwards to fix the hook. Moreover, he follows the plan of Dieffenbach. But on the one side this difficulty must be very rarely met with, for I have never seen it; and on the other, it is by no means easy to fix the hook when the lids are not well fixed. We cannot as well choose where to place the hook or forceps; and if you do not immediately succeed in fixing it, the muscles violently contract, the globe is immediately turned about in every direction, the lids close; and Dieffenbach and Phillips (who also practice this proceeding) confess that in this case it is better to put off the operation than persist in striving against these obstacles.

Are the forceps better than hooks? Boyer says the hooks are liable to prick the lids, scratch the cornea, and tear the conjunctiva in the restive motions of some patients. Phillips answers that the forceps armed with three claws make three punctures instead of one. It is certain that the hooks are less inconvenient in practice, but the forceps are incontestably the surest.

Is it better to confide the hook to an assistant, or for the operator

to hold himself the principal hook or forceps? I say the latter. It is dangerous to leave in the hands of your assistant (as Boyer acknowledges) the fate of an operation so delicate.

As to the difference about the single or double hook or crotchet, Dieffenbach has already given up the double. It is a less simple instrument than the other, and does not seem at all to be required.

Lastly, Phillips removes with a final cut of the scissors the remainder of the tendon that adheres to the sclerotic. It has no influence on the result, and consequently is only a useless cut of the scissors.

I have also spoken of the horizontal incision imagined by Boyer to prevent the projection of the eyeball. Whenever you conceive that the benefit of the vertical incision can be renounced, no proceeding, in my opinion, can compare with that of M. J. Guérin.*

(2.) *Section of the Obliquus Superior (Trochlearis muscle).*

Performed sometimes for the cure of strabismus upwards and inwards, but always after the section of the internal rectus. It has never yet been divided alone, and in the first place, for this simple reason, that the action of the muscles in strabismus is not clearly understood. Bonnet affirms that it has none, and that its section is, to say the least, useless. Gairal thought of dividing the insertions of the pulley of the muscle which is found towards the internal superior angle of the edge of the orbit: the proceeding would be simple enough, and only requires a puncture of the skin with a tenotome; but the operation is without object as yet, so it is useless to describe it. When, after, section of the internal rectus, the strabismus appears to persist, especially when the eye is turned inwards and upwards, the operation has been continued by laying bare and cutting the reflected portion of the trochlearis. You must not seek its sclerotic insertion, which is at least one inch from the edge of the cornea; but prolong the incision of the conjunctiva and albuginea upwards, and cut the adipose tissue directly upwards, and a little backwards, until the muscle appears. Some then pass a well-curved blunt hook, with its concavity, upwards, behind it; others simply cut it with a scissors. As you may see, the proceeding is not well settled: a great disturbance is made in the orbit; the flow of blood is more considerable than in section of the in-

* Dieffenbach, in 1842, applied for the first time a ligature on the sclerotic end of the muscle for the purpose of rendering the operation of strabismus more perfect and certain. Mr. Wilde, of Dublin, has also extensively adopted this method. When there is reason to believe that division of the rectus will not suffice, the following proceeding should be adopted: The muscle having been cut, as far back as it safely can be, its sclerotic portion should be seized and held with a forceps whilst a curved needle armed with a fine ligature is passed twice through it so as to secure it in a loop of the ligature, which should be tied round it. The end of the ligature may then be attached to the nose or cheek with a bit of adhesive plaster, so as to retain the eye in either direction as required. It should never be removed whilst it continues on the stretch; or, in other words, until the eye has completely righted itself. It does not seem to give much inconvenience. Mr. Wilde suggests that the ligature might be tied without dividing the muscle where strabismus is caused by permanent spasm, or shortening of the internal rectus, or paralysis of the abductor, and also for the purpose of restoring to position those eyes that have become over divergent after the usual operation.—See *Dublin Journ.* Nov. 1845, p. 211.

ternal rectus; and, if you use the blunt hook, the traction exercised on the muscle is very painful. Some operators, it is said, have cut the muscle before exposing it, after which they have made repeated searches for it; the least inconvenience of which is the pain and inutility. On the whole, I fear the operation has been performed without any well-marked indications; and the most exact experiments that have as yet been made on the functions of this muscle tend to prove that its action draws the eye downwards and inwards, instead of upwards. M. Bonnet, by whom this conclusion is arrived at, thinks that if the section of this muscle has seemed to do good, the benefit was caused by the separation from the eye to a great extent of the fibrous capsule, and thus the destruction of all the fibrous bands that kept up the strabismus inwards. This explanation may seem hypothetical; but the indication for cutting the trochlearis is still more so, and, until it has been better established, the best way is to abstain from it.

(3.) *Section of the Rectus Externus.*

Perfectly indicated in diverging strabismus, which is very rare, the operation is the same as for the internal, but two essential points must be mentioned:—1. The muscle is inserted one-third of an inch from the cornea, consequently a little further back than the internal rectus, and the incision should be made accordingly:—2. It is found immediately above the external angle of the lids, consequently there it should be sought. The superior and inferior recti have been divided, though more seldom still. The first is inserted three inches, the second two and a half, from the cornea; of course they must not be confounded with the corresponding oblique muscles. Many surgeons have divided several of these muscles at once. For this the incision in the conjunctiva is enlarged, and each muscle to be cut searched for.

(4.) *Section of the Obliquus Inferior.*

It has been performed by an incision in the conjunctiva; and M. Bonnet says that he has beneficially combined this section with that of the rectus externus in external strabismus. But when it is to be performed alone, as in certain cases of myopia, fatigue of the eyes, convulsive trembling, and even in some cases of amaurosis, it is simpler and easier to divide it at its insertion to the orbit by a subcutaneous incision. The obliquus inferior is inserted into the inferior edge of the orbit, at from a quarter to half an inch outside the lachrymal sac. No artery, nerve, or important organ is near this insertion; and a cutting instrument, passed between the inferior wall of the orbit and the muscle, cannot be brought forward without cutting it.

Proceeding of Bonnet.—The instrument used is a tenotome, pointed enough to traverse the lid, and blunt enough at the point not to be stopped in gliding over the floor of the orbit. The blade should be one inch and a quarter long, one line and a half broad, cutting only for one inch, so that when it has penetrated to the required depth, the blade is entirely concealed in the flesh.

The patient is seated with his head thrown back: if you operate on the left eye, stand on his right hand and place your left index finger on the middle of the lower lid, so as to make (*l'angle*) the angle (*Q. l'ongle*—the nail?) press immediately above the edge of the orbit; with this finger he pushes back the eye and lid, and thus exposes the middle of the inferior orbital edge. In front of the angle (*Q. nail?*) and immediately behind the orbital edge, he plunges in the tenotome—pushes it first downwards, until it has touched the floor of the orbit; and then passes it on, grazing the floor obliquely backwards, and inwards to the depth of three-quarters or one inch. When the point, which should never quit the osseous floor, has almost reached the ethmoid, the instrument, which has descended little by little to the horizontal position, is brought forwards; the point thus arrives under the skin a little outside the lachrymal sac; in this proceeding the obliquus inferior is necessarily raised. To make sure of having divided it, turn the edge downwards; then against the anterior part of the maxillary bone; so that the muscle, if not yet cut, may be compressed between the bone and edge, and that, in withdrawing the knife, it cannot fail to be completely divided.

If you operate on the right eye, stand on the right hand side, and behind the patient, to operate with your right hand, according to the general principle I have laid down. The moment it is divided, the lower lid swells with the effused blood; this swelling is painless, and goes down in twenty-four or forty-eight hours, and only leaves a slight ecchymosis, all traces of which usually disappear on from the fifteenth to the twentieth day. There is neither inflammation nor suppuration.

I had occasion to perform this operation on a subject whose sight was gradually lost, at the same time that the eyes projected more and more considerably. I used a simple ordinary pen-blade, with a concave edge, the point of which I had blunted. The result was that the pre-eminence of the eye diminished, and that the eye seemed buried in the orbit. As to the vision, it returned first in the eye not operated on, then in the other, but, curious to say in a less degree; but the amelioration was so satisfactory that the patient would not undergo the operation on the other eye.

SECTION IV.—OPERATIONS ON THE GLOBE OF THE EYE ITSELF.

I include under these operations those which exclusively interest the ocular conjunctiva; and in the first place I shall describe two operations relating to strabismus, and thus complete the foregoing section.

(1.) *Of the Cure of Slight Squint by Excision of the Conjunctiva.*

In slight cases of strabismus, it is to be feared lest the division of one muscle allow the eye to be drawn in the opposite direction by its antagonist muscle, and an internal strabismus, for example, be transformed into an external.

Dieffenbach then has recourse to a much simpler operation, which consists (for internal strabismus) in seizing the conjunctiva on the outside of the cornea, and forming a vertical fold some lines broad in it; then excising at once a portion of the conjunctiva and albuginea, close to the insertion of the rectus externus; a hook and scissors are all that are required. For external strabismus, a flap of the internal portion of the conjunctiva is removed, only it is said that the excision must be greater. It suffices to wash the eye with cold water, and the consequences of the operation are very slight.

Cunier wished to combine suture with excision, applying an operation proposed with another object, of which we are about to speak.

(2.) *Of Suture of the Conjunctiva to Remedy some Consequences of the Operations for Squint.*

After the section of the internal rectus, as we have said, the eye frequently projects abnormally, and sometimes also deviates a little to the other side, whence the two following proceedings.

Proceeding of M. Cunier.—By means of two hooks, he forms between the cicatrix and caruncula lachrymalis a vertical fold, comprising the conjunctiva and albuginea; and excises it with curved scissors; so far it is almost the same as Dieffenbach's operation for slight strabismus; but Cunier brings together the borders of the wound with two points of suture. Moreover, it is important if the albuginea has not been comprised in the fold, to raise it and excise it also.

Proceeding Guérin.—This is more complicated, and does not affect the conjunctiva only.

A young woman had, first, the internal rectus divided for an internal strabismus. Then, the eye having deviated outwards, the external rectus divided and resected but uselessly. Guérin commenced by seeking and destroying the new adhesions of the external rectus. Then he laid bare the end of the internal rectus, which he wished to attach a little more in front to the sclerotic; for that purpose the eye was obliged to be kept turned inwards; consequently a waxed thread was passed, by means of a sewing needle, through the thickness of the albuginea, close to the external border of the cornea. The eye thus held was drawn about one-third of an inch inwards, and maintained in this position by attaching the two ends of the thread to the nose with a bit of adhesive plaster; no accident followed. The next day, in the afternoon, the thread separated of itself, and, what is almost incredible, the eye had resumed its movability on the inside but not on the outside. As the cicatrization went on, the movements were re-established, and in less than eight days the eye recovered its form, its position, and almost its natural mobility. On the other eye the rectus externus had not been cut; it sufficed then to find the internal rectus, and bring it forwards with the thread applied in the same way. This is an operation that, without doubt, seems very fortuitous; but, when recourse is had to it, perhaps it would be better to join the end of the tendon of the rectus internus to that portion of the albuginea near the internal edge of the cornea.

(3.) *Of Pterygium.*

Of the three operative proceedings proposed for pterygium (incision, excision, and ligature), excision alone has remained in practice. The pterygium is seized with a tooth forceps two or three lines from its point and drawn towards the operator, then incised and dissected from point to base with a bistoury or scissors. It would be still more expeditious to raise it with a hook and excise it in one stroke of the scissors. Scarpa advises, when it is not thick, only to cut a semi-lunar flap out of it, opposite the point of union of the sclerotic and cornea. This proceeding is less sure. In some cases, I have recognized that the spot on the cornea is caused, not only by the pterygium, but also by more deeply-seated varicose vessels, on the tunica albuginea. These vessels themselves must be excised.

(4.) *Of Foreign Bodies in the Eye.*

Although foreign bodies may penetrate actually into the interior of the globe of the eye, they are said to be in the eye when they stick in the cornea or conjunctiva. They generally are bits of stone or iron, &c., which become fixed on the anterior surface of the cornea where they appear as spots. They seldom are large enough to offer any hold for the forceps. Fabrice of Hilden says that the magnet succeeds in drawing out particles of iron; I tried it once without success. The surest plan is to proceed at once to mechanical extraction. A polished ring, the head of a pin, a roll of paper, an ear-pick, have each been advised—these objects being passed over the cornea, and as it were scraping for the foreign body. If these fail, you are advised to dig it out with a toothpick or cataract needle. I shall only say that with pointed or sharp instruments you expose yourself almost inevitably to scratch, tear, or cut the thin pellicle that covers the cornea, which is just as well avoided, though I have never seen much mischief caused by it. I should then recommend blunt and polished instruments; perhaps an ivory toothpick is the best. I once saw a bit of iron fixed under the upper eyelid. I reversed the lid, and, scraping the conjunctiva with the blunt and convex edge of a Pellier's elevator, brought out the body with the greatest facility.

(5.) *Of Cataract.*

Anatomy.—There are several kinds of cataract; those which it is important for the operator to know are: *Membranous* Cataract—extremely rare on the anterior capsule, still more so on the posterior, and almost always complicated with adhesions of the iris, or other organic lesions; *Crystalline* Cataract, which occupies the lens, and its two varieties, the *hard* and the *soft*; in the latter the lens may be traversed by a needle without offering any resistance. The cataract is called *mature* (“*mûre*”) when the opacity is complete. In adults the operation is generally delayed until this period, it seems to me, without sufficient reason. Congenital cataract commences usually in a soft state, and is confined to the lens. After some years absorp-

tion begins to affect the lens, and the two layers of the capsule become opaque; afterwards the lens disappears entirely: the two layers of the capsule are confounded into one; the eye, deprived of its action, does not acquire its usual size, and the faculty of vision diminishes and is lost. After the age of twelve or fifteen, the operation restores only a confused sensation of light (Saunders), whence the necessity of operating on infants when very young—from the first to the second month after birth (Lawrence). From the sixth to the eighteenth (Middlemore). CATARACT is operated on by several methods. These are, *depression—extraction—Keratonyxis* and the *mixed method* proposed by Quadri. Before describing them separately, we shall point out some preliminaries common to all.

GENERAL PRELIMINARIES OF THE OPERATION.—These preliminaries affect the position of the patient and surgeon respectively, and the mode of fixing the eye. Sometimes the patient is operated on, sitting on a low seat and opposite the light, with his head leaning against the breast of an assistant, and the sound eye covered by a bandage. The surgeon sits before him on a higher seat, so as not to have to elevate his hand too much. Scarpa advises placing the foot on a stool, so that the knee may afford a resting-place for the elbow; others operate standing, the patient being placed on a sufficiently elevated chair. Lastly, Dupuytren leaves the patient in bed, in an almost horizontal position; the surgeon stands, leaning towards the affected eye—his elbow resting easily on the bed. The operation is performed on the right eye with the left hand, on the left with the right; though for my part I always use the right hand, placing myself before or behind the patient as I find necessary.

There are numerous proceedings for fixing the eye: some surgeons hold apart the lids with their own fingers, this is very easy when you operate on the right eye from behind. Roux has the upper lid raised by an assistant. When I operate on the left eye, and sometimes on the right, if the lids are deep and relaxed, I prefer the proceeding of Pellier, as follows: The surgeon depresses the lower lid with the index and middle fingers of the free hand, and at the same time presses slightly on the globe of the eye. The assistant standing behind the patient places one hand under his chin, and with a Pellier's elevator in the other, the curve of which is passed immediately above the tarsal cartilage of the upper lid, he gently pushes it back, and makes it almost entirely disappear in the orbit. In congenital cataract, the eye being excessively movable, the index and medius must be applied upon the free border of the inferior lid, one of these fingers pressing strongly on the globe at the side next the nose, and the other on that next the temple. (Middlemore.)

We must add here that pricking the conjunctiva having proved almost harmless in strabismus, it was very natural to propose in difficult cases to fix the eye either with a hook or forceps. This precaution seems to me especially useful, and is sometimes even indispensable when we would perform extraction.

I. DEPRESSION OF THE CATARACT (or *Couching*).—The form of the needle used for depression varies. That generally preferred in France

is Scarpa's—a fine shank of steel one inch and a half long, fixed on an ivory handle, and terminated by an enlarged flattened point bent in the arc of a circle, flat on its convex, spear-shaped on its concave side; or that of Dupuytren, which only differs from the former in being flat on its concavity, and the shank being slightly conical. For my part, I like the blade a little wider. The handle is marked with a black spot on the side of the convexity.

Ordinary Proceeding.—The patient being placed as we have said, and the eye well fixed, the surgeon takes his needle as a pen, rests his two last fingers on the cheek, and presents the needle to the eye in such a manner that the handle is inclined downwards and forwards, the point horizontal, the convexity upwards, one of the edges towards the cornea and the other towards the orbit. He then plunges the instrument perpendicularly into the sclerotic two lines from the cornea, and a little below the level of its transverse diameter. When all the curve of the instrument has penetrated, cause it to execute half a turn on its axis, so that the convexity looks directly forwards, which you recognize by the black spot on the handle; raise the latter and carry it a little backwards, so that the needle can pass without risk between the iris and lenticular capsule, until its point appears distinctly across the pupil. Then cause it to mount above the cataract; apply the concavity of the instrument on the summit of the lens, and depress it downwards, outwards, and backwards beneath the pupil and vitreous humour. Retain it there a minute to hinder it from rising; then disengage the instrument, gently rotating it, and bring it to the horizontal position; lastly, turn its convexity upwards, and withdraw it by the same passage as it entered.

If, before you withdraw the needle, you see the lens rise again, seize it afresh, and depress it a little more deeply. If it is too soft, and breaks under the instrument, depress the fragments one after the other, or divide them as much as possible, and push them into the anterior chamber, where they will be absorbed.

Lastly, if in the operation the lens escapes into the anterior chamber, you may either regain it with a needle, bring it back and depress it, or extract it through an incision in the cornea. Some surgeons have proposed a special proceeding, which consists in, after the section of the anterior capsule, applying the needle close to the upper edge of the lens and pressing on it, so as to turn it with its anterior surface upwards and its superior edge backwards; this is called *reclination*. But it is always necessary to depress it afterwards to render the passage for the light free. Reclination is then only a kind of depression; but I should add that it is really preferable when you expect to find the lens soft, and you would depress the lens and capsule together.

Proceeding of M. Bretonneau.—Bretonneau being afraid lest in the ordinary depression the lens should be pushed between the hyaloid membrane and retina, and the latter be wounded, begins by widely opening the hyaloid cells by causing his needle to penetrate from before backwards, downwards, and outwards; after which he returns in front of the lens, and continues the operation as usual.

New Proceeding.—This proceeding is founded on these established facts. First, that the lens rises again only when it is depressed with its capsule; the attachments of this latter being very rarely totally destroyed. Second, that the lens, when depressed with its capsule, resists absorption in a singular manner, so that it may rise a long while after the operation. Third, it is useless to depress the capsule, since, in extraction, it is left without inconvenience. The patient lying down or seated, the surgeon in front for the left eye, behind for the right, so as always to act with the right hand, pushes in a needle two lines from the edge of the cornea, half a line below the transverse diameter of the eye, the concavity of its blade turned upwards, and its point so directed as to pierce the posterior and inferior part of the lens. Having reached so far, he carries the needle gently backwards to divide the capsule, which gives a very clear sensation of resistance overcome; then, by a half circular turn in the vitreous humour, the needle is brought up above the lens so as for its concavity to look downwards; a simple movement of pressure then suffices to make the lens descend; it will not rise again, as the two walls of the capsule immediately collapse; you may at once withdraw your needle, and the operation is thus at the same time more sure and speedy. This is the proceeding I prefer when the crystalline lens has any consistence; but when it seems very soft, and not in a state to offer any resistance to the needle, I depress the capsule and lens together, as I have described for reclinatio.

II. EXTRACTION OF THE CATARACT.—The instruments necessary for this operation are—1. A cataract knife, generally Wenzel's lancet-shaped is preferred; its upper edge is blunt, almost to the point; or that of Richter, the triangular blade of which enlarges from the point to the heel. 2. A silver scoop called Daviel's. 3. Small forceps, and very fine scissors. 4. A *Kystitome*, or more simply a cataract needle. The knife suffices in the majority of cases.

Ordinary Proceeding. Inferior Incision.—The operation is performed in three steps. First—the eye being conveniently fixed, the surgeon holds the knife as a pen, rests his hands on the cheek, and presents his instrument to the cornea, with its point horizontal, and its edge downwards. He pushes it without hesitation across the cornea, perpendicularly to its axis,* and a little above its transverse diameter, about one line from the sclerotic; having reached the anterior chamber, he immediately inclines the handle backwards to avoid wounding the iris, pushes the blade horizontally, steadily, and firmly through the point diametrically opposite to that where it entered; and pushes the instrument on, keeping it parallel to the iris, until the inferior semi-circumference of the cornea is cut by the progress of the knife. This section should be made about one line from the sclerotic all round; at the moment of finishing, you may, in order to make the edge less oblique, turn the edge of the knife slightly forwards; but it is important to

* Some operators advise directing the knife perpendicularly towards the iris, and not obliquely, lest it should pass between the laminae of the cornea instead of into the anterior chamber. Mr. Guthrie, however, objects to puncture with the knife perpendicular to the eye.

avoid too strong pressure: at the same moment the assistant loosens the lid, which glides softly over the eye.

Second step.—After waiting some seconds, to allow the patient to become refreshed and collected, softly wipe the skin: the surgeon again raises the lid, or has it raised, ordering that no pressure be made on the eye. With the other hand, he presents the back of the *Kystitome* at the most inferior part of the wound, passes it in above the pupil, and turning the point of the instrument backwards, and its convexity downwards, passes from one side to the other of the upper semi-circumference of the pupil, so as to extensively divide the capsule of the lens.

Third step.—If the lens is not itself disengaged into the anterior chamber, it is made to go there by gentle pressure. The left index finger is pressed against the inferior part of the eye, whilst with the right the handle of the knife or scoop is placed across the upper lid, and moved to and fro on the globe of the eye, a little behind the lens. Soon the lens comes through the pupil, and presents its external edge at the wound; it is removed with a needle or scoop, and the operation is finished. If there remain any opaque portions of the capsule, remove them with a fine forceps, and, if necessary, scissors. Fragments of the lens may be extracted with the scoop; if they are small, and lodged in the anterior chamber, it is better to leave them to be absorbed, than risk irritating the eye by too repeated movements.

Proceeding of Wenzel. Oblique Incision.—Instead of passing across the cornea horizontally, the knife is entered in the middle of the superior external quarter of this membrane to be brought out at the point diametrically opposite. The flap is not inferior, but inferior and external: and the inferior lid is less liable to hitch in the lips of the wound. When the knife has reached to opposite the pupil, its point is applied against the capsule of the lens through the pupil, and an incision is made in it exactly similar to that in the cornea; that is to say, representing the segment of a circle with its convexity downwards; then the incision of the cornea is finished as usual. This measure, which is called the *tour de maître*, reduces the operation to two steps, and should always be tried when the mobility of the eye does not render it impossible.

Third Proceeding. Superior Incision.—Proposed and put in execution by Wenzel, Richter, Bell, &c. It is performed by introducing the knife horizontally, the edge upwards; then the upper semi-circumference of the cornea is cut into a flap. This proceeding exposes less to the loss of the vitreous humour, and separation of the wound by the action of the lids; but it is more difficult, especially when the eye is convulsively raised under the upper lid. It seems then only to suit in exceptional cases; for instance, when the cornea is very small, and requires incision of two-thirds of its circumference; or when the inferior half of this membrane is opaque or diseased: nevertheless, the success of Jaeger and of Graefe is a great argument in its favour. We think it might be adopted for the right eye, and that the surgeon would experience less difficulty in standing, as we have advised, behind the patient. As to the turning up of the eye under the lid, it is

rare, and may be combated by the application of the elevator of Pellier on the inferior fold of the conjunctiva, between the eye and the inferior lid, and especially by drawing it downwards with a rat's tooth, forceps, or a hook.

Section of the sclerotic has also been proposed, and even tried, for extraction of the lens; the dangers (perhaps exaggerated) of the operation have caused it to be generally rejected.

III. OF KERATONYXIS.—It requires no other instrument than an ordinary needle, and only the right hand. Some drops of tincture of belladonna are put between the lids a few hours beforehand to dilate the pupil.

Operation.—Everything being prepared, the surgeon, situated as usual, holds his needle as a pen, its convexity turned downwards, and supported with the index-finger of the left hand, the concavity directed upwards and forwards, so that the point acts in a direction perpendicular to the surface of the eye, it is plunged in on a level with the inferior border of the dilated pupil, and, arrived in the anterior chamber, it is directed obliquely upwards, across the pupil to the lens. The point of the needle is then pushed into the centre of it, and, by means of circular movements of the instrument, the lens is reduced to small bits, which are lost in the aqueous humour. The cataract may also be cut with the edges of the needle, and its fragments dispersed in the chambers of the eye, leaving the axis of vision as free as possible. It is especially necessary not to leave the instrument in the lens, but to withdraw it completely at each cut, and again plunge it in in a different direction. The operation finished, the concavity of the needle is turned upwards, and it is withdrawn in the same way as it was introduced.

Beer prefers a straight lance-pointed needle, as being more convenient for traversing the pupil and breaking up the lens. He pushes it into the cornea either at its inferior or at its external portion, but always about one line and a half from its circumference. If the lens is too hard to be divided, depress it. To effect this, a movement of rotation, that carries its convexity upwards, must be given to the needle; its point, after tearing the capsule, is directed on the upper part of the lens, and embraces it in its concavity, and a movement of elevation of the hand, well directed, depresses the other end, and with it the lens.

IV. MIXED METHOD. (*Quadri.*)—The pupil having been previously dilated with belladonna, pierce the sclerotic with an ordinary needle and proceed to depress the lens. At the same time, pass through the cornea another needle, to which are joined very small pincers, by means of which the capsule is seized. If it is soft, it should be completely destroyed; if it resists, draw it out and extract it by the wound in the cornea. The cicatrix that results is imperceptible.

Appreciation.—We can only argue theoretically about either of these methods. One seems to succeed in practice as well as the other; nevertheless depression, as I perform it, being the easiest and quickest, and leaving no danger of the lens's remounting; extraction, on the other hand, presenting a great difficulty in cutting the flap, and a

serious danger, viz., that of evacuation of the vitreous humour, I think the former ought to be adopted as the general method. Some circumstances may render either absolutely preferable. For congenital cataract in a young subject, it is best to introduce the needle through the sclerotic, and break it up; and generally in infants, the cornea being more loose and thick and closer to the iris, should be respected as much as possible. After the age of twelve, congenital cataract has become membranous; then an incision must be made through the cornea, and the membrane extracted with forceps; or if it is too hard, a circular opening must be cut from the middle of it with a very fine scissors, as near as possible to the circumference of the pupil, and the bit detached removed.

When opacity of the capsule is joined to that of the lens, you may depress both together, or have recourse to the mixed method. Generally, when the eyes are small and deep in the orbit, extraction is more difficult, and one of the other three methods should be used. In adults or old people, breaking it up through the cornea or sclerotic is suitable, when the cataract is supposed to be soft; if hard, depression or extraction. Moreover, whatever method is preferred, it is better only to operate on one eye at a time, and wait till it is cured before touching the other.

Persons who have been (even most successfully) operated on for cataract, require convex glasses to supply the place of the destroyed lens. In those who are born blind, Dupuytren used successfully a very simple plan of education for the sight. He fixed the hands of the patients behind their backs, by which means they were deprived of the sensation of touch, and obliged to guide and direct themselves by the eyes.

APPENDIX. OF THE MODES OF PRODUCING CATARACT ARTIFICIALLY.

—I have attempted to produce opacity of the lens in animals and on the dead subject, to afford opportunities of practicing the different operations for it. Troja proposed putting it in contact with an acid. M. Leroy d'Etiolles has recourse to electric discharges. Neuner of Darmstadt uses a solution of six grains of corrosive sublimate, in 3ii of pure alcohol. With this solution he fills a small glass syringe, furnished with a small metal tube, through which passes a very fine stylet. An opening having been made on the external side of the eye, the tube is passed through it as far as the posterior surface of the lens, into which is pushed the stylet, which opens a way for the tube itself; the stylet is then withdrawn, the injection is thrown in, and the lens whitens almost immediately. It would be simpler to use a canula of Anel's syringe, strong enough to traverse the capsule of the lens; or again a glass tube, drawn out fine enough in a lamp through which you might drive the liquid by blowing into it; or again, the small tubes we have described as used for cauterization of the teeth.

(6.) *Formation of an Artificial pupil.*

Recourse is had to this operation either for accidental or congenital obliteration of the pupil, or when opacity of the centre portion of the

cornea prevents the light from traversing the natural pupil. We proceed by incision (*corétomie*), excision (*corectomie*), or tearing of the iris (*corédialyse*).

Surgical Anatomy.—The iris, stretched as a veil between the lens and cornea, is distant about one line from the cornea towards the centre, and approaches it till it is in contact with it at the circumference; behind, it is close to the capsule of the lens, so that it is difficult not to injure the latter, in acting on even the anterior surface of the iris, and impossible on the posterior. Lastly, the iris is continuous in its large circumference with the ciliary circle and processes. The texture of the iris is little understood. The appearance of fibres, radiating at its great circumference, and circular near the pupil, has for a long time caused it to be supposed that there exist two antagonist muscles. Numerous facts prove this hypothesis to be false. Sometimes we have in an artificial pupil, made in the middle of these radiating fibres, the movements of dilatation and contraction (Janin). Generally, the section of these fibres does not produce any spreading of the wound, so that these anatomical ideas are of no value in influencing the method of operation; only we should say that, when the iris is perfectly healthy, or the obliteration of the pupil, either congenital or accidental, is not of long standing, you may to a certain extent count on this faculty of dilatation and contraction. But when the obliteration is very old, or is caused by chronic inflammation, these properties are generally lost; more certainly still if inflammation has brought on adhesions between the iris and capsule of the lens. The application of belladonna causes a strong dilatation, a circumstance of which Ch. Bell advises us to reap the advantage in forming a pupil by incision.

I. METHOD BY INCISION.—It comprises several proceedings.

Proceeding of Cheselden.—He used a kind of needle, broader and not so pointed, as that for cataract, and sharp on one side only. He plunged it through the sclerotic half a line from the edge of the cornea, passed it across almost all the posterior chamber. Arrived at the posterior part of the iris, he turned the point against that membrane, and in such a way as to cut it across, and divide it enough, in withdrawing the instrument, to make a horizontal incision, from which should result an oblong pupil, more open in the middle than at the ends, almost like a cat's (Morand). Sharp and W. Adams have modified the proceeding of Cheselden by pushing the instrument from behind forwards in the anterior chamber, to incise the iris from before backwards.

Proceeding of Janin.—He opens two-thirds of the cornea with a Wenzel's knife, as for extraction of cataract; then raising the flap, he traverses the iris with the point of one branch of a curved fine scissors, and cuts it vertically.

Proceeding of Maunoir.—He makes a semicircular incision on the cornea, comprising at least one-third of its circumference; then introduces the scissors, one point of which is blunt and the other sharp, traverses the iris with its sharp point, and makes a vertical incision, to which he joins an oblique, making a V.

Proceeding of Velpeau.—He passes a knife, rather narrower than that of Wenzel, and sharp on both sides, into the anterior chamber, cautiously pushes it through the iris, and after it has passed in two or three lines into the posterior chamber, brings its point out again into the anterior chamber, through the iris, from behind forwards; then he finishes the section of the cornea as for extraction of cataract, only the incision of this membrane is accompanied by a semicircular incision of the same form as the iris.

II. METHOD BY EXCISION.—All the proceedings may be reduced to three.

Proceeding of Guérin.—A semilunar incision being made in the cornea as usual, cut the iris transversely; then divide each lip of the wound, so as to have a crucial incision; and, lastly, excise the four angles with a scissors.

Proceeding of Wenzel.—Make a semicircular flap in the iris and cornea, both at once as in the proceeding of Velpeau, which, in fact, is only the first step in Wenzel's; then, raising the flap of the cornea, seize that of the iris with a forceps, and cut it off with curved scissors so as to leave a circular opening.

Physick invented a pair of forceps, with oval ends like a pair of tongs, with which the bit of iris was grasped and cut off both at once.

Proceeding of Gibson.—He opens the cornea, to the extent of three lines, with a cataract knife, one line from the sclerotic. The aqueous humour immediately flows out: and the iris comes in contact with the cornea, the wound of which it plugs up; a slight pressure should then be made superiorly, and near the nose, with the index and middle fingers, until the iris protrudes, and forms a little sac the size of a large pin's head outside the wound. This portion should be cut off with a scissors, and the pressure immediately removed. When the iris recedes, the section will be found more or less circular. When the iris adheres to the cornea, this projection or hernia cannot take place; in this case, a non-adherent bit of this membrane must be drawn out with a small hook, and cut off as usual. When the whole, or a great part of the circumference of the iris adheres to the cornea, the operation is more delicate still: after section of the cornea, these adhesions must be destroyed with a cataract knife, and not till then must the iris be drawn out with the hook. The proceeding of Beer does not differ from this, only that, in case of adhesion to the centre of the iris, he makes the pupil in another spot.

III. METHOD BY DETACHMENT. (*Décollement.*)—It was performed by Assalini in 1786; but Scarpa made a method of it.

Proceeding of Scarpa.—A cataract needle was plunged through the sclerotic as in depression, and passed to the superior internal part of the circumference of the iris, near the ciliary ligament; then the point of the instrument was turned forwards, and brought through the borders of the iris without touching the cornea. The iris was then pressed downwards and outwards, parallelly to its anterior surface. In this manner it was detached from its ciliary connections to a suitable extent, from three lines to half its circumference. If the lens seemed transparent, the needle was withdrawn; if not, he depressed or de-

stroyed all that was opaque. Schmidt recommends, when the cornea is healthy, to pass the needle through that membrane. Numbers of ingenious instruments have been made for this proceeding, most of them acting the part of forceps or hooks. But experience has shown that, after these proceedings, the iris is liable to regain its position and attachments—whence the following

Proceeding of Donegana.—It is a combination of detachment and incision. He performed the detachment after the method of Scarpa, but with a needle sharp on its concave side, so as to incise the iris after having detached it.

Proceeding of Langenbeck.—He makes a very small opening in the cornea, which will not allow the iris to recede when once it is drawn outside. By this opening, he introduces a small hook in a golden tube; a small, simple or double, hook is just as well. He pierces the circumference of the iris with his hook, and gently detaches it to a suitable extent, drawing the flap into the wound of the cornea. When the flap is firmly fixed in the opening, so as to leave no danger of its slipping back, the hook is withdrawn, and the operation is finished; the iris contracts firm adhesions with the cornea, and the pupil cannot be obliterated. As the danger of tearing the iris is to be feared in proportion to the quantity of it drawn out, the opening in the cornea should be as near the edge detached as possible; but, of course, so far that the opacity of the cicatrix will in nowise obstruct the passage of the rays of light across the new pupil. It may be seen that it would be easy with a more extensive incision to unite excision to detachment.

IV. METHOD BY EXTENSION OF THE NATURAL PUPIL.—When the iris is in a normal state, but the cornea has become opaque in its centre, Langenbeck proposes a new operation, which has not been sufficiently attended to or observed.

He makes a small incision of the cornea near the sclerotic, seizes the pupillary edge of the iris, and draws it through the edges of the wound, which retain it first by constriction, afterwards by solid adhesions.

Appreciation.—It will be seen at once that not one of these methods is suitable for every case, nor can replace all the others. In what manner soever the incision is made, it always leaves the reunion of the lips of the wound doubtful; consequently, it is an operation to be rejected. When the pupil is obliterated, but the cornea healthy, excision is certainly the most rational method.

The proceeding of Guérin is too complicated; that of Gibson at first sight seems easier, but it has a great drawback; the section of the cornea will be too close to the pupil, and the cicatrix will obstruct the vision; or too distant, and then the employment of the hook becomes necessary, and you risk tearing the iris: the proceeding of Wenzel seems then to deserve preference. If the cornea is obscured in the centre, the method by extension of the natural pupil is worth trying. If the pupil is itself obliterated, or if the extent of the opacity will not allow you either to risk tearing it through the cornea, or to draw the natural pupil far enough out of the way, excision may be

tried; or, as a last resource, detachment and hernia. The proceeding of Scarpa, as all those that act through the sclerotic, almost inevitably injures the lens or its capsule, and theory would make us dread a consecutive cataract. Happily, experience contradicts these fears; and I should say that I have obtained a very tolerable success by simple detachment with the needle. Perhaps the plan of Langenbeck is more certain. You would risk nothing in this case by making your incision of the cornea through the opaque portion, as MM. Faure and Lusardi have proved that cicatrization takes place just as well.

(7.) *Formation of an Artificial Cornea.*

When the cornea is opaque, in consequence of staphyloma or any other affection, an attempt may be made to restore to the patient at least the perception of light, and even of objects. In Germany, especially, some curious proceedings for this purpose have been proposed: we shall say a few words about them, because they are but very slightly known in France; and they may throw light upon some questions, and serve as an answer, for example, to the greatest objections against extraction of cataract through the sclerotic.

Pellier first proposed to excise the cornea, to replace in its circumference a crystal cornea. This curious idea has not, and doubtless never will, be tried on man; it has never even been tried on animals. Ammon, in a case of adherence of the iris to the cornea, tried to detach the iris from the less opaque portion of the cornea, to allow the light, at all events, to pass. The operation only rendered the cornea more opaque than before. Others have had the idea of transplanting on the human eye the cornea of some animal;* or again to detach a slip of the cornea in the shape of a pediculated flap, and apply it on an opening made in the sclerotic. Astonishing to say, names justly celebrated in surgery have given their approbation to these magnificent projects. But the most important proceeding, for it has been oftenest tried on man, is that of Autenrieth. It consists in detaching a flap of the conjunctiva and albuginea, to lay bare the sclerotic, a circular bit of which, and of the choroid, is cut out, so that the hyaloid membrane is exposed. It was hoped that a transparent cicatrix might have been obtained; and in fact during the first three or four days the patient perceived the light, and even motions of the hand or fingers; but afterwards the cicatrix became as opaque as the sclerotic itself; in one case, however, he still retained the perception of light,

* This idea has actually been put in practice. M. Plouviez, who has been experimenting on the subject of transplantation of the cornea, "*Keratoplastie*," for five years, and has frequently performed the operation, has never obtained a perfectly transparent cornea. Vision has been more or less established, but never completely. Amongst the cases is one of a young woman who became blind at three years of age after the small-pox. Having removed the opaque cornea, he fixed in its place, by four points of sutures, the cornea of a young dog killed for the purpose. The grafting succeeded; but the patient could only distinguish the light a little better, and was still unable to walk alone. According to M. Flourens, however, we must still not despair of the success of these experiments. M. Feldmann has long been engaged in them, and appears to have arrived at much more satisfactory results, promising complete success.—*Gaz. des Hôpitaux*, Aug. 21, 1845; see Half-yearly Abstract of Med. Sciences, Dr. Ranking, vol. ii. p. 235.

which was so great a comfort that he requested to have the operation performed on the other eye.

(8.) *Of Hypopion.*

Formerly it was advised to puncture the cornea with a small trocar, or to incise it with the cataract knife. In the present day, when the abscess is considered to be acute, there is too much probability of increasing the inflammation, and producing opacity of the cornea. When it is chronic, the matter secreted adheres to the iris or cornea; and lastly, as the absorption removes it altogether, the operation has been given up.

(9.) *Of Hydrophthalmia.*

The trocar and incision through the cornea, or sclerotic, have been proposed. An incision, a line or two long, through the cornea, is the least dangerous; the aqueous humour flows out, and an immediate relief follows. Some days afterwards, if necessary, it may be repeated. M. Bassedow has been four times successful in this way. In the most serious cases, recourse is had to excision of the cornea, in order to procure complete evacuation of the humours of the eye, and to transform this organ into a small movable mass, capable of supporting an artificial eye. The proceeding is simple and easy; the inferior half of the cornea is divided as in extraction of cataract, then, seizing the flap with a good pair of forceps or a tenaculum, detach it from the rest of the circumference with a bistoury or scissors. Blandin recommends at the same time excising the iris.

(10.) *Extirpation of the Globe of the Eye.*

Ordinary Method.—The operation varies according as the lids participate or not in the disease. When the eyeball alone is affected, the patient being seated or lying down, the surgeon fixes the tumour with his fingers, or, what is better, an assistant holds it with a forceps, prolongs the external palpebral angle about an inch towards the temple, and dissects downwards and upwards the lower and upper lid. He then plunges in his bistoury, held as a pen at the internal commissure, penetrates along the ethmoid bone to the optic foramen, and grazes from within outwards the inferior semi-circumference of the orbit, taking care to divide the attachment of the obliquus inferior. Having reached the external angle, he re-enters his knife at the internal angle, and grazes the superior orbital semi-circumference, including in the parts to be removed the lachrymal gland.

The eye is now only retained by a pedicle formed by the four recti muscles and the optic nerve. Cut it across with a bistoury or curved scissors; whatever be the instrument used, you are advised to pass it to the bottom of the orbit along its internal wall, doubtless to avoid injuring the ethmoid bone. Desault, with reason, preferred to follow the external wall, which is shorter, more oblique, and in every way more convenient for the operator. The tumour removed, try with the finger that you have not left any diseased parts. The largest artery is the ophthalmic; small plugs or pellets of lint suffice to stop

the bleeding. When the lids are affected, you begin by removing the diseased portion of them.

Proceeding of Dupuytren.—He commences by detaching the eye from the superior wall of the orbit, and cutting its pedicle across; he then turns it down and draws it forwards, and dissects it out from behind forwards on the cheek.

(11.) *Introduction of an Artificial Eye.*

In general, we should wait until the surface is healed before we place an artificial eye. This does not happen before the fourth month, sometimes not until the eighth or twelfth. Wenzel recommends its immediate introduction, to prevent reunion of the lids to the mass or bottom of the orbit; this advice seems to us applicable only when there is no other mode of hindering this union. In describing the proceedings of introduction and extraction, we shall give the words of M. Hazard-Mirault.

Proceeding of Introduction.—Choose an eye, at the farthest no more than half an inch long and one-third broad; take it between your right thumb and index finger, dip it in water, raise the upper lid with your left hand and slip the largest part of the eye under it; when you have it introduced, direct it a little towards the external angle and retain it there; then allow the lid gently to descend, quickly draw the lower lid from under it, and the eye is introduced.

This eye should not rest *in situ* more than eight or ten hours, or from morning to evening. After this first trial, you can judge what size eye will do next; and, after using it for a short time, a larger will fit; thus you go on gradually increasing its size, though it need never be so large as the healthy one. It is well for the eye to float easily in the orbit behind the lids, and cover the deformed eye without fatiguing or strongly pressing any of these parts.

Proceeding of Extraction.—A long pin with a rather large head is required; or, better, a silver or golden needle about three inches long and about the thickness of a knitting-needle, terminated at each end by a little hook with a rounded head. The oculist holds this needle as a pen; with the fingers of the left hand he depresses the lower lid, and passes between it and the artificial eye one of the hooks of the needle, which is passed on the enamel until it meets its inferior border. Then he depresses the right hand towards the cheek, and, without pulling it towards himself, uses the needle as a lever—raising the artificial eye, which, being no longer supported by the lower lid, slides along the needle, and falls into his left hand, which is quickly moved from the lid to catch it.

Immediately after the extraction, the eye must be put in clean water, to clear itself of the thick mucus with which it becomes covered.

CHAPTER II.

OPERATIONS PERFORMED ON THE AUDITORY APPARATUS.

(1.) *Perforation of the Lobule of the Ear.*

THIS trivial operation may be performed with a common bodkin or a small hydrocele trocar; but a trocar, with a conical angular shaft tapering to the point, is generally used. They are made of gold or platinum, but steel is evidently better. The sensibility of the lobule is first blunted by slight pressure; then it is put flatly on a bit of cork, and the instrument driven boldly through it with force enough to cause the trocar and canula to enter the cork to some depth. The trocar is then withdrawn, and a bit of lead wire passed through the canula, which is then also withdrawn. The lead wire is now bent into a ring, and left in until the opening has become permanent.

(2.) *Excision of the Lobule.*

Boyer saw an instance in which the lobule was so long and misshapen, that it became quite a deformity. He traced in ink the shape he wished to leave it, and removed the superfluous portion with the scissors. The wound healed readily, and the deformity was removed.

(3.) *Otoplasty.*

The loss of the lobule, or even of part of the tragus, may be repaired by the autoplasmic method. Dieffenbach has successfully tried it.

Proceeding of Dieffenbach.—The diseased edge of the ear having been pared, he cuts from in front on the temple, or at the superior part of the concha, or behind on the mastoid process, a sufficient flap of skin; this he dissects after the method of Celsus, so that it may be stretched without twisting its pedicle, and brought into contact with the raw edge of the lobule, to which it is attached by points of interrupted suture, including the entire thickness of each part. A roll of lint covered with dressing is passed behind this kind of bridge, to prevent the retraction of the dissected skin, and the whole is covered with compresses saturated with marshmallow water. When the adhesion is pretty firm, that is to say, after three or four days, the needles may be removed. But the flap must not be separated from the cranium until from the fifteenth to the thirtieth day, for fear of gangrene. Care must be taken, in making this separation, to give the portion attached to the lobule the required form, and to let it be at least half as large again as the loss of substance; then it is dressed separately from the wound it leaves on the head. Its cutaneous surface corresponds to the external surface of the lobule. It retracts and becomes thickened and

hardened. At first it is pale, then becomes red, and for a long time is more coloured than the rest of the lobule.

(4.) *Obliteration of the Auditory Canal.*

This obliteration is complete or incomplete, congenital or accidental; it is caused by either an approximation of the osseous parietes, in which case we cannot do anything; or the abnormal approximation of the soft parts in the whole extent of the canal; or, lastly, a membrane more or less deeply placed, and which performs the office of a diaphragm.

When the auditory canal is closed from birth, it is difficult to judge whether there exists a simple membrane only, or whether there is total absence of the canal. For this doubtful case an incision may be made with a bistoury, to the depth of a line or two. If then no space is found, the canal does not exist. If, on the contrary, it is met with, the external incision may be enlarged, and a tent, a bit of bougie, or a canula, or some dilating body be placed in it, which is renewed and left in for some time after the cicatrization. You would act in the same way, if the obliteration was accidental.

When there is only a simple membrane, if it is not deep, incise it crucially, with a very sharp bistoury, covered with lint to within two lines of its point; and, if possible, remove the flaps. If it is very deeply situated, you may carefully use a trocar, the point of which is very little longer than the canula; but cauterization, with nitrate of silver, proposed by Leschevin, is preferable. In all these cases, even when the obliteration is incomplete, we can only keep the canal open by placing dilators in it, and afterwards an ivory or metallic canula, left in permanently, or applied at intervals.

(5.) *Of Foreign Bodies in the Ear.*

Anatomy.—The external auditory canal, longer in the adult than in the infant, attains in the former the extent of nearly an inch; it is directed obliquely inwards and forwards, and follows a curved course, so that its inferior wall is convex, its superior concave. Its internal end is closed by the membrana tympani, stretched obliquely from above downwards, and from without inwards, in such a way that it seems to be a continuation of the upper wall, which is consequently shorter than the lower; the canal is larger at its extremities than in the middle, and presents an elliptical transverse section; the disposition of which it is of the highest importance to know, in the extraction of foreign bodies.

This elliptical form of the canal is the more marked the younger the subject; moreover, in infants, the greatest diameter of the ellipse has constantly a direction almost parallel to that of the zygomatic process, consequently, almost horizontal; as we advance in age, the development of the mastoid process seems to elevate the posterior extremity of this diameter, so that at puberty the diameter is oblique from above downwards, and from behind forwards; in the adult, it approaches the perpendicular, which it attains almost completely in the aged.—(Lenoir.)

Operative Proceedings.—The foreign bodies that get into this canal are of divers natures, and give rise to different indications; they may be arranged into four classes, viz.:—

1. *Hardened Wax.*—This should be first softened, either with injections of oil or warm soap and water, or salt water, or even pure water, and then extracted with an ear-pick.

2. *Living Insects.*—For instance, a louse, a bug, or an earwig. If you cannot entangle them in a bit of unravelled cotton or wool, catch them in a bit of glue or pitch on the end of a probe, or seize them with a forceps; you must kill them by pouring into the canal oil, hot water, or still more active liquids.

3. *Soft Bodies.*—Cotton, paper, dead insects, grains, or seeds—pass an ear-pick between them and the parietes of the canal beyond them, and use it as a lever. If they are too large, divide them with any narrow and slightly sharp instrument, and extract bit by bit.

4. *Hard Bodies.*—Bits of gravel, glass, lead, cherry-stones, &c. Here the difficulty is great; we have several times seen Dupuytren fail in his attempts.—The surgeon, sitting down, places the patient kneeling between his legs, and holds him with his head turned back on his thigh, so that the affected ear may be exposed at the same time to the light, and to the view of the operator. Assistants hold the patient, and prevent him from moving.

Begin by lubricating the passage with oil; then the surgeon, drawing the tragus upwards and backwards, takes a small curette, which he passes along the inferior wall of the canal beyond, or at all events as far as, the foreign body, which he tries to push upwards and outwards, using the curette as a lever of the first order. The curette must be passed along the inferior wall; this precept extends to the introduction of any instrument, for the following reasons: The membrana tympani extending obliquely from above downwards, and from without inwards, there is less danger of wounding it; the vertical diameter of the canal being greater than the transverse, there is more chance of finding a space for the instrument there than anywhere else, especially with a round body. (Boyer.)

As you will observe, these remarks only affect the anatomical position of the canal in the adult. In children the instrument should be carried along the anterior wall of the canal, varying it according to the ages; neither does it seem well demonstrated that the best way to get beyond the foreign body without injuring the tympanum is along the inferior wall. This wall certainly is the longest, but its convexity does not permit the instruments to follow it in its entire length; and, as it obliges them to be directed exactly inwards, the instrument goes right against the membrane—whilst this membrane, forming a sort of continuation to the superior wall, the instrument passes almost parallel to its external surface, and there is less chance of its being wounded. I habitually follow this course, and have never had cause to repent it.

Proceeding of Mayor.—M. Mayor has published several successful cases in which he used only injections of water, forced into the auditory canal by means of an ordinary syringe, the jet of liquid, passing and

accumulating behind the substance, impels it forward with considerable force. I should remark that I tried this plan without success, when I succeeded with a bit of iron wire bent to represent a curette.

(6.) *Of Polypi of the Auditory Canal.*

They are of two kinds; some are simple excrescences, easily extirpated; others, depending on a more serious affection, are vegetations of a malignant nature, which spring up again immediately after their removal.

Cauterization, Ligature, Excision, and Extraction have been proposed. The three first proceedings are suitable only when the polypus is not deep, and do not need special precepts; but sometimes, for ligature or excision, the polypus should be drawn outwards with a hook.

Extraction is suited for all cases. Dupuytren performed it with very small steel tongs, having a small hook at their extremity; carry them as deep as possible on the polypus, bury their hooks in its substance, then rotate them and the polypus, so as to break its root, or drag it straight off. The blood that immediately escapes so masks the parts that we are generally obliged to put off the rest of the operation till the next morning.

(7.) *Perforation of the Membrana Tympani.*

Attempted for the first time by Cheselden, reproduced by A. Cooper; it is performed by puncture, caustic, or excision.

I. PUNCTURE. *Proceeding of Sir A. Cooper.*—He used a small curved trocar, the point of which does not extend at farthest more than a line and a half beyond the canula. Place the patient so that the solar light may fall exactly on the canal. The surgeon, sitting down, draws the tragus upwards and backwards to make the canal as straight as possible; then holding the trocar as a pen, with its point inside the canula, he passes it up to the anterior and inferior part of the tympanum, and then pushes the point through it. The vessels intersected are so small that there is very little bleeding; if there is any considerable quantity, other parts must have been touched. When the operation succeeds, the patient regains his hearing immediately. This puncture only makes a very small opening, which is liable to obliteration, whence the following proceeding:—

Proceeding of Buchanan.—He uses a quadrangular trocar, which he passes through the membrane at about the middle of the space between its centre and inferior border; causing the point to penetrate to a depth of about one line, rotating the handle at the same time in opposite directions. His intention is to widely cut across the fibres of the membrane, and throw apart the lips of the incision.

II. CAUTERIZATION. *Proceeding of Richerand.*—He advises us to make the opening by means of caustic, to obtain a loss of substance. His plan has but few partisans.

III. EXCISION.—Himly first invented a very imperfect instrument (*un emporte pièce*); it was since improved by Fabrizi of Modena, and by Deleau. The instrument of the latter consists of a canula with a

cutting extremity containing a shank hollowed out as a corkscrew, and terminated by a little thin disk, the circumference of which also offers an edge facing that of the canula, the instrument being passed to the membrane; the shank is by a motion of rotation passed through the membrane, and, when it has reached a depth of about one line beyond the membrane, a spring, which is let loose, brings back the sharp disk against the edge of the canula, cutting out the bit of membrane between them. This plan is much superior to the others, but it does not always succeed.

(8.) *Perforation of the Mastoid Cells.*

First pointed out by Riolan, afterwards performed by Jasser, and some others, and perhaps too lightly abandoned. It may be had recourse to in some cases of deafness, and especially to empty an abscess in the mastoid cells. It must be remembered that these cells do not exist in very young persons; and that the largest are a little in front of the mastoid process, seven or eight lines above its summit.—The external surface of this process is laid bare as for the operation of trepanning, and a small trepan or perforator applied on the bone, in the indicated direction; sometimes even a simple trocar suffices. If there is any caries, a gouge and mallet may be serviceably used.

(9.) *Catheterism of the Eustachian Tube.* (Fig. 15, o.)

Anatomy.—The Eustachian tube is a semi-osseous, semi-cartilaginous, and membranous tube, about one inch and two-thirds long, establishing a communication between the tympanum and pharynx. It descends obliquely inwards and forwards, without any curve, so that the beak of a curved catheter could not pass far into it. Consequently, flexible catheters are of more service. The position of its pharyngeal orifices is very badly marked out. It has been well said that it may be found two inches and some lines from the anterior orifice of the nares; but some raise it to the level of the middle meatus, others at least opposite the attachment of the inferior spongy bone. I have proved that it corresponds exactly to the external wall of the meatus inferior, at almost an equal distance from the floor and the insertion of the spongy bone; and, if the latter did not present an obstacle, we should reach it directly by passing the beak of the sound against the external wall of the meatus: it looks downwards, inwards, and forwards: it is bounded above and behind by a perceptible elevation, so that the beak of the sound passed along the floor of the nasal fossa, beyond the inferior meatus, need only be raised by a movement of rotation outwards in a quarter of a circle, without leaving the external wall of the nostril, to slide into the orifice of its own accord. Catheterism of the Eustachian tube is performed by three different passages—by the mouth—by the corresponding nostril—or by the opposite nostril; we only have recourse to it in order to make injections.

FIRST METHOD.—Imagined by Guyot, post-master at Versailles, in 1724; it has had but few partisans, and is generally abandoned.

SECOND METHOD.—Invented by Cleland, in 1741. It is performed in three ways.

Ordinary Proceeding.—A sound, curved like a female catheter, but smaller, and without eyes at its sides, but open at each end, is used, carefully oiled before it is introduced. The patient being seated on a chair, with his head slightly thrown back and supported on a pillow, the surgeon standing before him, or a little to one side, takes the instrument as a pen, and presents its beak at the nostril, on the same side as the obstructed tube, and passes it rapidly on the floor of the fossa, its convexity looking inwards and a little upwards, its concavity downwards and outwards; at about two inches depth, he reaches the velum of the palate, which is announced by the patient making a sudden effort at deglutition. The beak is then turned outwards and upwards by a movement of rotation given to the shank, without quitting the external wall of the nostril, so as to reach the superior part of the maxillary meatus; and, in continuing to push in this direction, you reach the opening of the tube, which passes obliquely outwards, backwards, and upwards. The sound is pushed in to a sufficient depth by a moderate pressure. To make the injection, a syringe must be fitted into the mouth of the tube. If the injection is stopped in the Eustachian tube, the syringe should be withdrawn, and a blunt probe introduced as far as the obstacle to destroy it.

Proceeding of M. Deleau.—He substitutes for the silver sound a gum elastic sound of the same shape, supported by a silver stylet four or six inches in length and about one line in diameter, presenting a pretty strong curve at one end and a ring at the other. The sound is passed in the usual way as far as the opening of the tube; the stylet is then pushed into it, beyond the sound, and the sound afterwards pushed in also upon it; then the stylet is withdrawn: a lip of silver is fitted to the external end of the sound, with a bit of wire on it that grasps the ala of the nose as a forceps.

M. Deleau prefers injections of air to injections of liquid. He inserts the spout of a syringe or caoutchouc bottle into the mouth of the wound. He recognizes, by applying his ear to the diseased ear, whether the air gets as far as the tympanum, and whether it can get out again between the sides of the tube and sound; in which case a double current of air is established, that going to the tympanum through the sound, and that returning to the pharynx.

Proceeding of M. Gairal.—When the beak of the sound has reached the posterior orifice of the nasal fossa—in other terms, the extremity of the osseous floor—M. Gairal causes it to describe a *quarter of a circle* by a slight movement of rotation outwards; then, advancing a few lines, it passes right into the orifice. This rotation, limited to a quarter of a circle, is in exact accordance with the anatomical facts I have stated.

It is so essential, that M. Gairal has engraved on the side of the lips of his sounds figures indicating to the operator when the movement is complete. If it is not extensive enough, you descend into the pharynx. If too extensive, you strike against the internal side of the base of the pterygoid process. The orifice being occupied by the beak of

the sound, you have now to penetrate into the canal. Gairal indicates, as the third step of the operation, to continue the movement of rotation, to raise the beak upwards and outwards, at the same time pushing it in. The curve of the instrument should be determined according to the directions of the nasal fossa and tube. Boyer used a sound with a curve of 136° ; Gairal prefers one at 145° .

THIRD METHOD. (*Deleau.*)—When the corresponding nostril is from any cause obliterated, you may enter the tube from the other, with a more slightly curved instrument, the beak of which is turned back a little towards its convexity. It is passed with its concavity turned downwards and inwards, along the inferior border of the septum. When once arrived at the velum of the palate, a movement of rotation should be given to it sufficient to raise its extremity behind the vomer, and reach the tube; the rest as usual.

The patient himself, if he has ever been operated on before, will tell you if the sound is badly placed. It may, moreover, be known by the position of the sound, or by injecting air or water. If the sound is well placed, the injection enters the cavity of the tympanum, or does not reach it at all. If it is badly placed, the injection falls into the pharynx.

It is better to push the sound briskly, though gently rather than too slowly, as it causes less pain and fatigue. M. Velpeau asks, would not cauterization be better than injection for clearing the tube?

Appreciation.—The proceeding of Gairal is certainly the best, theoretically, and should be preferred when the nasal fossæ are not obstructed; perhaps two inches is too long for the curved portion of the sound, and renders its rotation in so narrow a space difficult. When there is an obstruction in the nasal fossa, on the side corresponding to the tube, only two resources remain: the last proceeding of Deleau, and the primitive proceeding of Guyon. I think the latter might be successfully applied, with the precaution of putting the index finger to the bottom of the mouth, as far as the posterior nares, to recognize the projection formed by the superior lip of the orifice, and so direct the instrument. Doubtless on the living subject we should have to contend against the contraction of the velum of the palate and pharynx; but, these difficulties overcome, the finger very easily reaches the orifice, and at once recognizes it.

CHAPTER III.

OPERATIONS PERFORMED ON THE NOSE, AND OLFACTORY APPARATUS.

(1.) *Of Rhinoplasty.*

ALL the methods of autoplasty have been applied to this operation; we might add two others, used in India, if our European civilization did not cause us to reject them in an absolute manner.

1. *Transplantation of a Nose from another Person.*—There are some rare facts which permit us to conceive the bare possibility of such a thing.

2. *The formation of a new Nose from Integuments taken from another Person.*—M. Dutochet says, that for this purpose they borrow a flap of skin from the buttock of a slave. The details of these operations would be quite superfluous here; it suffices to have mentioned them.

I. METHOD OF CELSUS.—Successfully employed by Larrey and Dieffenbach, it is applicable in two different cases; sometimes there is a real loss of substance, comprising the entire thickness of the walls of the nose; in which case, the skin of the cheek is dissected, and brought forward to form the sides of the new nose, and the septum is cut from the upper lip. All these flaps should be united by suture, and supported so as to prevent their coming apart.

It is much more usual to see the nose depressed than completely destroyed after syphilitic or scrofulous diseases; whence the special proceeding we are about to describe.

Proceeding of Dieffenbach.—A young girl had lost the bones of her nose, the vomer, the greatest portion of the nasal process—the malar bone, and the lamellæ of the ethmoid; the integuments of the nose

were folded into the nasal fossæ, and presented, instead of the natural projection of this organ, a tortuous fissure that gave the countenance the aspect of a skull. The patient was seated on a table with her back supported by cushions; M. Dieffenbach made all along each side of the nose an incision down to the bone; there resulted a band of isolated integument only attached above and below, at each end, and wider at the bottom than at the top. A vertical incision, down the median line, divided this portion of skin; the lateral incisions were continued inferiorly, by two semilunar incisions, which detached the alæ

Fig. 16.



Rhinoplastic or Taliacotian operation.—The nose is supposed to have been operated on by the proceeding of Dieffenbach:—*b*, the needle passed through the cheek. The dotted lines represent the flap to be dissected up in the Indian method.—*a*, the flap to be made into the columna.

of the nose from their external adhesions. The two flaps were then dissected from below upwards, out of the fossæ, where they were folded; the cut edges of the cheek were also detached from the bone

for a little distance. All these dissections finished, he brought together the borders of the median incision, after having sloped off their internal surfaces to hinder them from again folding inwards, and united them by six points of suture; eight other points of suture served to maintain in contact the lips of the lateral incisions, the internal surfaces of which were also sloped off, and then the nose appeared to have regained its shape and prominence. A band of skin that remained with the septum, being too short, turned the point of the nose inwards; it was lengthened by means of two small incisions in the upper lip.

Then he placed in each nostril a tube of quill, enveloped in oiled lint; and lastly he passed a long, thin needle through the dissected integument of the cheek beneath the new nose: this needle was furnished with a leather head, and the point he twisted up with a pincers, so that it kept the lateral surface of the nose in contact with those of the cheeks, and augmented the projection of the organ.

The nose, thus reconstructed, being pale and cold, it was covered with compresses moistened with warm wine and water. In the evening, the heat and redness had reappeared; on the third day, almost all the points of suture were removed; on the tenth, the long needle. During the ten following days, the inside of the nose was frequently cauterized, and washed with injections; it eventually became covered with a cutaneous layer of new formation. The columna, which was too narrow, sloughed from the fourth day, and was removed with the scissors. M. Dieffenbach made another with a bit of integument taken from the upper lip.

II. ITALIAN METHOD.—Amongst moderns, Graefe is the only one who has employed it under the name of the German method.

Proceeding of Graefe.—He begins by making the patient wear, at night, for some time, a kind of laced waistcoat surmounted by a hood which solidly embraces the head, and to which are attached four or six straps fastened on to the sleeve of the arm to furnish the flap, so that the patient, as much as possible, gets used to keeping his arm up to his nose. The position being well fixed, a bit of leather is cut out to the exact size required; Graefe always makes it, on account of the consequent retraction, six inches long by four broad. This model is applied first on the nose, then on the arm close to the nose, so as to exactly establish the relations they should keep to each other. The flap is cut on the anterior and internal side of the arm, the point upwards; it is dissected from above downwards, so that it remains adherent by its base; the edges of the openings of the nostrils should be refreshed, and the flap applied and fastened by the interrupted suture. The *serre-nœud* is here very useful for giving to the suture the suitable degree of constriction; lint must be placed in the nostrils to keep the flap raised, and the arm is fixed to the head by means of the hood and straps.

When union has taken place, which varies from the fourth to the thirtieth day, the flap may be divided at its base from the arm, which may then be left free; out of this base must be cut the *alæ*, the openings to the nostrils, and the columna, of the nose; the lint must

be removed, and what remains to be united must be brought together by suture; the nostrils being kept open by a bit of quill, or gum-elastic tube.

III. INDIAN METHOD. *Ordinary Proceeding*.—A model of the flap required is made with paper or wax, and applied on the forehead, the point downwards, and corresponding to the root of the natural nose; and the limits of the flap traced with ink or nitrate of silver, so that the blood may not efface them. (Lisfranc.) Care must be taken to give the flap two lines more extent in every direction, in order to obviate the effects of retraction.

These preliminaries accomplished, the borders of the openings of the nose must be refreshed; then the flap is dissected off the forehead entirely, with the exception of that part next the root of the nose. It is now reversed on the base; and, in order to leave the bleeding side inwards, it must be turned on its pedicle, so as to bring the skin outside. Its edges must then be applied exactly on the refreshed edges of the old nose, and held together everywhere by stitches, except in the part where the nostrils are to be. Lint smeared with ointment should be placed in the nostrils, to keep them open, and at the same time support the new nose.

When the agglutination is pretty firm, the sutures may be removed, and the pedicle of the flap divided on a director. There remains a small flap, which may be united by suture to the old nose.

To give to the nostrils and nose a suitable shape, Graefe introduced into them canulas containing a spring tending to carry them forwards, and thus render the point of the nose more prominent.

Proceeding of Delpech.—Instead of cutting from the forehead a perfect model of the new nose, which leaves a roundish wound very difficult to heal on account of its shape, Delpech cut the base of the flap in three points, so that there remained on the forehead three V-shaped wounds. He afterwards cut out the three points to suit his convenience in forming the septum and wings.

Proceeding of Lisfranc.—His principal modification has for its object to avoid torsion of the pedicle of the flap, which hinders the cicatrization, and exposes to gangrene. This torsion arises, especially in the ordinary proceeding, from the fact, that the two incisions which bound the pedicle descend to the same level. Lisfranc prolongs his incision on the left side three lines and a half lower than on the right, and then dissects in such a manner that a line, starting from this last point to directly reach the first, would form with the axis of the face an angle of 45° . The other innovations are less happy: for instance, Lisfranc supports the new nose with a plug of lint put in permanently before the reunion of the flap, and which he afterwards extracts by the orifice of the nostrils; the result is that, in order to keep the opening large enough, he cannot at once unite the septum. Lastly, after cicatrization is completed, he does not divide the pedicle.

Proceeding of Blandin.—He follows the ordinary proceeding until the parts are fixed together. But then, instead of dividing the pedicle of the flap, he removes the skin of the root of the nose from under it, and applies the pedicle in this manner on the nasal bones, when they exist.

Appreciation.—The method of Celsus is only applicable to considerable losses of substance, and the particular proceeding of Dieffenbach has also a special indication. The following is the opinion of an illustrious German surgeon on the applicability of the different methods, when the loss of substance is more considerable. The Indian method is especially suitable when the bones of the nose are wanting, and when the forehead is high and covered with healthy skin. Unless under these circumstances, or when the others are impracticable, we ought to reject it. The Italian method is always the best when we can use it under favourable circumstances, on account of its leaving no cicatrix on the forehead. The reunion by first intention, or German method, is only applicable to robust, strong persons. The second intention, or Italian method, properly so called, may be adopted when the two others are forbidden by the general vulnerability (“*vulnérabilité*”) of the skin. (Graefe.)

This appreciation seems to us a very just one. But the Indian method is that which is generally adopted. With it the proceeding of Delpech is evidently the most favourable as regards the cicatrization of the wound on the forehead. That of Lisfranc offers a considerable advantage in reducing almost to nothing the torsion of the pedicle. But we would not adopt the introduction of a plug of lint into the nares, which would prove an obstacle to the reunion of the columna. Simple *mèches* of lint suffice, and have not this inconvenience. We might, if necessary, also combine with it the transverse needle of Dieffenbach. As to the modifications of Lisfranc and Blandin tending to avoid section of the pedicle, it seems to us that their most probable result is to increase the deformity. It is useless to say they provide against gangrene. Gangrene is no longer to be feared after reunion has taken place: witness the success Graefe has had with the Italian method. The ordinary proceeding, which cuts the pedicle and unites it by suture, leaving only one linear wound without projection, appears to us preferable.

(2.) *Restoration of the Ala Nasi.*

The ala of the nose may be restored by a flap borrowed from the cheek or upper lip. But when the loss of substance is slight there is another method, much more ingenious, which consists in masking the deformity by a fresh loss of substance instead of repairing the old one. It has been once tried by Dieffenbach with complete success.

Method of Dieffenbach.—A bistoury is introduced into the nostril of the side on which the ala is wanting, and carried along the septum dividing, from within outwards and longitudinally, the middle part of the dorsum, as far as the edge of the nasal bone of the same side. This done, at the upper part of the incision apply the bistoury transversely across the sound half of the nose, and divide it down to the cheek, giving this incision a slightly oblique direction backwards and downwards, almost parallel to the free border of the nasal bones.

The bistoury is reapplied some lines below this section, so as to again divide this half of the nose in its entire thickness, and join the first section at its base, and to remove a bit of the nose in the shape

of a wedge. This is for the purpose of giving to the two alæ the same length; consequently the thickness of the slice to be removed should depend on the extent of the loss of substance which constitutes the deformity. It now only remains to reunite the parts: viz., the inferior part of the sound half of the nose to its superior; and then this lateral half, thus shortened, to the deformed.

Dieffenbach unites with pins, which he passes from one edge of the wound to the other, as in the twisted suture; but he is satisfied with curving the pins on each side to maintain the parts together, dispensing with thread. The ends of the pins are cut off as near the integuments as possible, and the points of suture are at most not more than a line or a line and a half apart. Evidently the interrupted suture might just as well be used.

The result of this method is that the length of the nose is diminished, and its tip raised so as to leave the patient, instead of a Grecian or aquiline nose, a *nez retroussé*, or “à la *Roxelane*.” If the nose is already naturally *retroussé*, or if the loss of substance be so considerable as to require the length of the nose to be much diminished, the proceeding is scarcely applicable.

(3.) *Restoration of the Columna.*

This operation has been tried in three different cases. 1. After a rhinoplastic operation, when the portion destined to form the columna had sloughed, Dieffenbach borrowed a flap from the upper lip; but we do not know the details of his operation. 2. In certain cases of complicated hare-lip of which we shall treat hereafter. 3. In a case of destruction of the septum and cartilage, the consequence of ulceration of the skin to a depth of three-quarters of an inch, Dupuytren acted as follows:—

Operation.—The surgeon, armed with a very narrow-bladed bistoury, commenced by refreshing what remained of the septum; then he cut, after having exactly taken its dimensions, the necessary flap from the upper lip on the median line, but without going so far as the free edge of the lip, and only cutting through half its thickness. He took care also to bring up his incision farther on the left than on the right side. The flap dissected in this way was turned up by twisting its pedicle from left to right, and fixed to the point of the nose by two needles. Two other needles united by first intention the wound made in the lip. Two plugs of lint smeared with ointment were placed in the nostrils to keep them open, and the whole supported by adhesive bandages, the middle of which served to sustain the columna, whilst the ends were fastened to the forehead, cheeks, and temples. The operation succeeded; but the torsion of the pedicle left a disagreeable projection, and the columna also was too large. At last, the end of the nose, being drawn down by the cicatrix, gave this organ a flattened form. Gensoul of Lyons remedied this by the following proceeding:—

The base of the flap was bounded by a V incision, and the loss of substance in the upper lip was easily united by a needle; then the surgeon removed, by means of two incisions, a middle band in the en-

tire extent of the columna, and reunited the two lateral portions by means of a point of interrupted suture. The operation was most successful.*

(4.) *Tumours developed on the Nose.*

The treatment does not differ from that of other tumours; only a special anatomical disposition has caused the proceeding of extirpation to be modified.

Proceeding of Rigal.—It is founded on this fact: that the cartilages of the ala of the nose, in meeting at the median line, leave between them a space, sensible to the touch in most subjects, which allows of their being separated, and of our penetrating to the septum without opening into the cavities of the nostrils.

A cancerous tumour having developed itself under the anterior spine, and spread forwards, downwards, and on one side as far as the alæ without affecting its integuments, Rigal bounded it laterally by two incisions united in front, diverging behind and outwards in the shape of a Y upside down. A transverse incision united them below, and the integuments were dissected off; he thus reached the cartilage of the septum, the anterior border of which he had to remove with the tumour. The cure was good; only the cicatrix, drawing backwards the tissues, at last slightly flattened the alæ and the point of the nose.

(5.) *Occlusion of the Nostrils.*

Whether it be complete or incomplete, we may remedy it by all the mentioned means of removing obstruction generally. But here especially the conformation of the parts renders dilatation useful: it may be kept up with canulæ of ivory or lead.

(6.) *Polypi of the Nasal Fossæ.*

Anatomy.—There are four principal kinds. 1. *Mucous or Vesicular polypi*, formed of an external membrane and a very soft cellular tissue, gorged with serosity, sometimes enclosing very distinct vesicles. 2. *Fibrous polypi*, formed of an accidental fibrous tissue covered by a membrane. 3. *Fleshy polypi*, which are red, soft, and sensible, but not painful. 4. *Fungous or carcinomatous polypi*, sometimes soft, red, and bleeding at the least touch; sometimes hard, scirrhus, with lancinating pains. These are the *malignant polypi* of authors, which J. Bell says are never anything else but a degenerescence of others. The mucous polypi generally spring from between the superior and middle spongy bones near the maxillary sinus, sometimes from the upper wall. A. Cooper never saw them on the middle septum of the nasal fossæ. The others are fixed almost indifferently above or on the sides. Implantation on the floor of the nasal fossæ is excessively rare. Sometimes they are directed towards the anterior, sometimes towards the posterior orifice of the nostril. The polypi that acquire the greatest

* Fergusson and Liston prolong the incisions through the free margin and entire thickness of the lip, and do not twist the pedicle of the flap formed, but leave the mucous surface external.—F. B.

volume, and go so far as to separate, disjoint, or perforate the bones and cavities, are the fibrous. They are liable to degenerate, but, remarkable to say, this degenerescence always commences in the parts most remote from the pedicle, which constantly retains its fibrous character. (Dupuytren.)

In addition to these different kinds of polypi, A. Cooper has observed in children a sort of tumefaction of the pituitary membrane, which has the aspect of fungus.

A great number of proceedings have been employed against polypi. *Exciccation*, *seton*, and *compression* by means of plugging, are generally rejected. There remain *cauterization*, *torsion*, *extraction*, *excision*, and *ligature*.

I. CAUTERIZATION.—You may use nitrate of silver, liquid nitrate of mercury, or butter of antimony. A. Paré employed for the same purpose aquafortis and vitriol. M. Saint Amand touches the mucous polypi with lapis infernalis. A. Cooper also used this for the fungosities in children.

Proceeding of Jensch.—He employed a mixture of sulph. acid, butter of antimony, and nitrate of silver. His conductor is a metallic wire in the shape of a long pin, with a head as big as a large pea. This head is covered with a layer of the caustic, and passed to the projecting part of the polypus, and this touching repeated from two to five times. An hour before and an hour after this cauterization, an aluminous injection should be passed into the nostril. The operation should be repeated in this manner every day, until the tumour is destroyed. When there remains no more than the pedicle, you need only touch it with the lapis infernalis, but continue on the injection for two months; and, to give back the sense of smell, the powder of the *napeta* (*teucrium verum*) in the shape of snuff is prescribed. M. Wagner says he has tried this plan with much success on the most obstinate polypi.

II. TORSION.—The patient being seated opposite the light with his head thrown back and held by an assistant, the surgeon puts aside the ala of the nose with the fingers of his left hand, and with the other hand introduces the polypus forceps shut. When he has reached the tumour he opens them, and passes them in as far as possible. When the polypus is firmly grasped in the forceps, they are twisted round always in the same direction, at first without any traction: then when it is judged that the torsion of the portion grasped is sufficient, he draws the tenettes towards himself, and recommences thus until the whole of the polypus is extracted.

III. EXTRACTION.—Is performed through the anterior or posterior part of the nostrils.

1. *Through the anterior part.*—The polypus is seized as for torsion, and drawn out, giving the instrument a slight movement of rotation on itself. If the polypus yields and advances towards the opening of the nostril, a second forceps is taken like the first, with which it should be seized nearer its root; and the same manœuvres must be continued until it comes away, the root being broken off. It is often very useful to introduce the left middle and index fingers by the mouth, their palmar surfaces upwards, as far back as possible, so as to push for-

wards the polypus between the teeth of the forceps. Sometimes the polypus tears, in which case you must repeatedly begin again; or the effusion of blood may be so strong as to mask all objects, and force you to put off the operation to another day.

When the tumour is of considerable size, and hard, two difficulties present themselves—it cannot be seized with the ordinary forceps, because it so fills up the nasal fossa that they cannot be passed up; or it cannot be got out through the narrow orifice of the nostril. The first inconvenience is remedied by using the disarticulated tenettes, which are used like the forceps (Richter); and the second by incising the ala of the nose outwards at its union with the upper lip. (Dupuytren.)

2. *By the posterior nares.*—Curved tenettes are used, introduced by the mouth, and guided on the left index finger to the tumour. It will be seen that the shape of the tenettes must vary, some being curved on the flat, others on the side; and that their curve prevents any torsion on the root of the polypus, which renders the operation less certain.

In a case in which a very large polypus could not pass from the nostrils to the mouth through the posterior nares, Manne divided the velum of the palate which opposed its exit. This plan succeeded, and has been often successfully imitated since.

IV. *EXCISION.*—A probe-pointed bistoury is used for the excision, narrow, and guarded with linen just up to its point; or curved scissors of various lengths. The polypus should be seized in the forceps or hooks as far forwards as possible, and brought to view, so that the knife may act on its pedicle.

Excision is performed, according to the case, by the anterior nares, or by the posterior; but, in the latter case, the curved scissors alone are applicable.

Proceeding of Wathely.—In a case of very large polypus with an extensive pedicle, Wathely first placed a ligature round it, and introduced by the nostril a bistoury concealed in a sheath, with an eye, near its point, through which he introduced one end of the ligature. An assistant held the other end; the instrument was thus surely and immediately guided to the pedicle, which was no less than two inches in diameter in one direction, and one inch and a half in the other. It was gradually excised with success.

V. *LIGATURE.*—Ligature consists in a loop of thread introduced by the nose into the pharynx, which, when it is withdrawn, embraces the pedicle of the polypus, and is then tightened by means of a *serre-nœud*.

The great difficulty here is to direct the loop on the pedicle of the polypus. Of all the proceedings invented to overcome it, the following seems to us the best.

Proceeding of A. Dubois.—A strong and sufficiently long loop of thread is prepared, and kept open by a segment of an elastic sound, from one-half to one inch long or more. To this segment, which runs freely on the loop, is attached a coloured thread; and another thread is knotted to the middle of the loop itself. This apparatus being ready

a gum-elastic sound is passed through the nostril in which the polypus is situated. It bends down into the pharynx, and is there reached with the finger, and its extremity brought into the mouth. The end of the coloured thread and the two ends of the loop are attached to the eyes in the end of the sound, and the whole drawn back through the nose. We have now three threads hanging from the nose, which serve to draw the loop in this direction, and at need to free it from the segment of the sound; and a fourth thread coming from the mouth and serving to withdraw the loop downwards in case of failure. The conducting sound may now be withdrawn, as it is of no further use. The surgeon then plunges his index and sometimes the medius finger with it into the bottom of the mouth, and bends them up to reach the posterior part of the nares—recognizes the polypus, the position of which should have been previously studied, and tries to direct the loop so as to completely embrace it. When he thinks he has succeeded, he tells his assistant to pull both ends of the loop together and the coloured string. If this traction meets an obstacle, it is a sign that the loop is well placed; if, on the contrary, the loop comes away without resistance, it has failed in its object. It must then be drawn back again by means of the thread left in the mouth, and be tried again. The fingers should not be withdrawn until you have finished; at least, unless the state of the patient require it. When the polypus is firmly embraced by the ligature, the segment may be withdrawn by the coloured thread. The two ends of the ligature should be passed into a *serre-nœud*, and the polypus strangled to the required degree. The *serre-nœud* is left on; the thread in the mouth may also be left, and attached to the outer end of the instrument. Every two or three days the constriction of the ligature should be increased; on from the eighth to the tenth the pedicle is cut, and a pretty strong movement of traction brings away the polypus with the *serre-nœud*.

Dupuytren replaced the segment of sound by an elastic spring, such as is used in braces.

Proceeding of M. Felix Hatin.—Hatin invented an instrument that at the same time keeps the loop of thread open and directs it on to the pedicle; it is a blade of steel, nine inches long and one and a quarter broad, bent at a right angle at one end, and with a wire running along its middle, supporting the ligature. The ligature having been passed by the nostril, and brought through the mouth in the ordinary way, the middle of the loop is attached to the wire; the two ends of the loop are kept apart by the blade. The instrument is passed to the bottom of the mouth with the curved portion upwards, and the vault of the pharynx thus reached. By pushing the wire that maintains the loop, the latter is made to mount to the end of the blade; and, when it passes beyond it, an assistant pulls the end of the loop, which necessarily embraces the pedicle of the polypus, if this pedicle is attached to the roof of the nasal fossa.

This instrument, very simple and sure in effect, cannot be used for polypi that are inserted on the lateral parietes of the nasal fossæ; for these latter Hatin is obliged to have special instruments, consisting in fact of the same fundamental blade, only with different curves.

Proceeding of Rigaud.—This is another instrument, consisting of three steel bars curved at their extremities, held together in a canula, able to spread or be brought together at will. Each of them has at its extremity a small eye, the top of which opens with a certain effort. The ligature drawn through the mouth is put into these eyes; the three branches are then passed into the pharynx and sufficiently separated; the ligature, being pulled, slips out of the eyes, and necessarily grasps the polypus as by the instrument of Hatin.

Appreciation.—Cauterization requires fresh facts to be established before it can take rank amongst the ordinary methods. Simple torsion suits very well for mucous polypi, which tear so easily under the efforts of simple traction; and generally it is useful to combine it with extraction. The worst of excision is the difficulty of directing the knife. A. Cooper also thinks that it favours their reproduction more than extraction. But generally extraction and ligature suffice for all cases—extraction for polypi near the anterior orifice, ligature for those near the posterior.

The proceeding of Hatin is better than that of Dubois, on account of its facility and promptitude. The manœuvring with the fingers in the pharynx almost always excites cough, nausea, movements of deglutition, and threatened suffocation, which annoy the operator, and displace his fingers in their researches. We have seen Dupuytren repeatedly fail from these causes. The choice of the *serre-nœud* is of much less importance. The best, in our opinion, is that of Graefe, modified by Dupuytren. After any of these operations, the patient must be made to sneeze, to see if the air freely passes; and remember before you guarantee a certain cure, that polypi may be numerous, and are very apt to be reproduced.

(7.) *Plugging of the Nasal Fossæ.*

We have recourse to it only for stopping hemorrhage, uncontrollable by any other means.

Operation.—First make a plug of lint, large enough to stop up the posterior nares, and tie it firmly with a bit of waxed thread, the ends of which may be left pretty long; another simple thread of the same length should be fixed to the plug; the rest of the apparatus consists of a bit of lint and a gum-elastic sound. The gum-elastic sound is passed through the affected nostril, and its end brought out through the mouth; to the eye of this sound, the double thread of the plug is fastened; in withdrawing the sound the thread is drawn through the nose with it, and the plug pulled into the posterior nares, where it becomes fixed. The two ends of the ligature round the plug are now separated, and another plug put in between them anteriorly, on which they are tied, after which the ends may be cut off. The single thread that was attached to the first plug is stuck to the cheek with a bit of plaster, or tied to the patient's cap.

After two or three days, when you judge that the hemorrhage is stopped, cut the thread that retains the anterior plug, and draw out the lint with a forceps. There only remains the posterior plug, which is pushed back with a sound; whilst, with the string left in the mouth,

it is prevented from falling into the throat, and is withdrawn by the mouth.

(8.) *Perforation of the Frontal Sinus.*

An occasion requiring perforation of this sinus is very rare, and offers itself only in case of abscesses which do not open into the nostrils, or of polypi developed in these sinuses. A gimlet or small trepan is employed. Velpeau advises us, in order that the opening may be in the most depending part, to apply the instrument beneath the eyebrow, between the supra-orbital notch, and the root of the nose. It should be directed backwards, upwards, and inwards. It is often difficult to close this opening, whether natural or artificial, on account of the passage of the air; we should have recourse, if necessary, to the general proceedings for the obliteration of fistulous openings.

(9.) *Catheterism of the Maxillary Sinus.*

Proposed and successfully performed by Jourdain, in a case of retention of mucus in the sinus, in a woman who had lost her teeth, and on whom several different perforations had been tried without success, on account of the pain they caused. The patient being seated in an arm-chair, with her head thrown back, the operator introduced into the nostril of the affected side a hollow sound of the same calibre as those used for exploring the nasal canal, but not so curved, and about two inches longer. He passed the slenderest part of this sound under the vault of the ethmoidal spongy bone; and having recognized a kind of gutter, formed by the folding of the pituitary membrane, and situated about two lines from this arch, descending along the convexity of the inferior spongy bone, he slightly elevated his wrist, applying the instrument against the wall of the sinus, into which he pushed it, pressing slightly against its opening which was obliterated, as it almost always is in retention. The sound being thus introduced, he passed injections through it, and left it in until the next day; then he removed it, causing the patient to blow her nose, when a large quantity of mucus came away; he continued to introduce the sound for the purpose of injecting, for six weeks, when the patient was completely cured.

It is a very useful plan to make the patients blow their nose, or even to inject and wash out their nostrils beforehand, especially if they are snuff-takers. There are some important anatomical relations to be borne in mind. In the first place, the entrance to the sinus (Fig. 15, *d*) is situated above the inferior spongy bone, almost in the centre of the middle meatus. To introduce the sound into it, it should be directed obliquely upwards, backwards and outwards, so as to penetrate about one inch and a quarter, and on a level with the superior fold of the ala nasi. The beak of the sound is gently passed under the middle spongy bone, and easily reaches the orifice; a movement of rotation will then pass it into the sinus. Sometimes the opening is a little farther back than usual; the middle spongy bone quite conceals it; the septum is inclined towards it, or the opening may be quite obliterated. In all these cases, when from any reason

the natural orifice cannot be found, there is no harm in forcing an artificial one, by pushing the sound through the mucous membrane, or through the thin lamella of bone that forms the internal wall of the sinus.

(10.) *Perforation of the Maxillary Sinus.*

Anatomy.—The maxillary sinus, or antrum, represents a kind of triangular pyramid, the base of which corresponds to the external wall of the nasal fossa, and the three sides to the base of the orbit, to the cheek, and to the alveolar arch. It may be opened in either of these four points. First, its base, situated vertically from before backwards, parallel to the septum narium, commences half an inch behind the osseous border of the nasal orifice, immediately behind the ascending process and nasal canal. It is divided into two parts by the inferior spongy bone: the inferior portion helps to form the inferior meatus; the superior, concealed by the ethmoidal spongy bone, forms, with it, the middle meatus. In the middle of this meatus, and immediately above the inferior spongy bone, is the nasal orifice of the antrum, a simple foramen, with thin edges, varying in size in different patients. 2d. The orbital wall, formed by the floor of the orbit, commences two or three lines from the edge of the orbit, from which it is separated by the infra-orbital foramen and orifice of the lachrymal canal. 3d. The external wall is divided into two portions by the zygomatic arch; the posterior part is too deep to be accessible to instruments; the anterior is thinnest in the canine fossa, at about half an inch above the two small molars (bicuspides). 4th. The inferior wall, the narrowest of all, corresponds to the alveoli of all the molar teeth on their internal side; but the two alveoli that almost touch the sinus, from which they are sometimes only separated above by the mucous membrane, are those of the first and second large molar teeth.

Such are the relations of the sinus in the normal condition; but when it is distended by a cyst, a polypus, or a fungous substance, all its parietes become extended and thinned; the inferior wall occupies the arch of the palate; the internal wall pushes the septum of the nose to the other side; but the anterior wall is the one that spreads most.

The antrum is perforated to empty an abscess or cyst, or to extract a polypus, a fungus, or foreign body that may have entered from without.

We shall not do more than mention perforation through the floor of the orbit, pointed out in the article on fistula lachrymalis, and the perforation of the nasal wall, tried by Gooch, it is said, successfully; but its anatomical situation renders it too difficult to be adopted.

1. *Perforation by the Alveoli.*—This proceeding consists in drawing the tooth mentioned, and piercing the bottom of its alveolus with a stylet (Henerman), a trocar (Richter), or a perforating trepan (Desault), and then keeping the opening free. For this purpose, Bell advises the introduction of a wooden plug, to keep out any morsels of food; others recommend a permanent canula.

With regard to the choice of the tooth to be extracted, we have

seen that all the molars correspond to the sinus. Juncker advises the extraction of the first or second (or the bicuspid); Cheselden, the third or fourth. I lay down this general rule—*When there is only one carious molar tooth, whichever it may be, it is the one that should be extracted*; only it should be remembered, that the perforator must be passed directly from below upwards for the four last molars, but slightly backwards also, for the first bicuspid. If, however you have your choice, the second bicuspid is to be preferred, as nearer the sinus than the first, and less used in mastication than the two others.

2. *Perforation of the External Wall.*—You can reach this wall by an incision made in the cheek; but this proceeding is justly rejected, as it is more easy and advantageous to open the sinus by the mouth. An assistant, with a blunt hook, or more simply his finger, draws the angle of the mouth upwards and outwards, so as to strongly raise the upper lip, and turn it back on the cheek. The gum must then be incised at about three-quarters of an inch above its edge, and we reach the osseous wall of the sinus. Lamorier perforated immediately below the zygomatic process, above the third molar; Desault justly preferred the canine fossa, where the parietes are thinner. You may use a stylet, trocar, or trephine, or more simply a strong scalpel, which may be turned round four or five times in the opening, so as to enlarge it; a tent of lint must then be left in it.

3. *Perforation by the Roof of the Palate.*—This method cannot be applied in the normal condition. Callisen recommends it only when fluctuation can be felt there; and in most cases in which it has been performed, there existed a fistula in the mouth, which it was only necessary to enlarge. In this way, Ruffel introduced a trocar through the fistula, brought it out above the gum, and then passed a seton, through this double opening. Nessi advises passing a seton in this way even in ordinary cases. Weinhold, on the contrary, first opened the sinus by the canine fossa, making the counter opening from within outwards in the roof of the palate.

Appreciation.—When the relations of the sinus are not altered, and a simple opening suffices, perforation by the alveoli and canine fossa are about equally good. The first should always be adopted when a tooth has been drawn, or is carious; but when the dental arch is sound the second is much more simple, as the perforation of bone is almost the same, and incision of the gums is not so inconvenient as the loss of a tooth.

When there is a cyst, with liquid contents, the sinus is generally dilated, and its parietes thinner and easier to divide with a scalpel. A large opening must then be made, directed from before backwards, with loss of substance; and the general rules that we have laid down for cysts in bone adopted. Here also the anterior wall must be attacked in preference, and the same for the extraction of foreign bodies and polypi, or fungus of the antrum; but in these cases the horizontal incision, even with some loss of substance, will often not suffice; and Dupuytren advises combining with it a vertical incision, extending from the internal extremity of the first, as far as the base of the orbit along the ascending process of the maxillary bone.

An enormous development of the sinus, the presence of fistulæ, of other circumstances, which cannot be foreseen, of course would modify the operation.

CHAPTER IV.

OPERATIONS PERFORMED ON THE MOUTH, AND ITS APPURTENANCES, OR THE GUSTATORY APPARATUS.

(1.) *Mucous Excrescences of the Lip.*

Anatomy.—We sometimes observe, on the internal surface of the free edge of the upper lip, more rarely on the lower, a sort of red congenital excrescence, sometimes in the form of one or several tubercles, sometimes like a transverse fold, which tends to turn the lip outwards when the patient speaks or laughs. It is a sort of hypertrophy of the labial mucous membrane.

Operation.—An assistant turns back the lip so as to expose its internal surface; the surgeon, with a pair of forceps, seizes the excrescence transversely, and as widely as possible; raises it a little, and with a pair of scissors curved on the flat, or a bistoury, completely excises it. The even wound that results needs no dressing, and generally cicatrizes very promptly.

(2.) *Swelling of the Upper Lip.*

Anatomy.—Swelling of the upper lip, generally a sign of scrofula, occurs also in subjects free from this disease. On dissection, we generally find the cellular tissue very thick, and more or less infiltrated with serosity; the muscles pale, discoloured, sometimes as thin as those of very old people, more rarely thickened by the interposition of cellular tissue between their fibres; the mucous membrane also sometimes participates in this hypertrophy.

Operation. (*Paillard.*)—Seat your patient on a low chair with his head leaning on your breast as you stand behind him. An assistant, with his thumb and index finger, holds the labial commissure on the right side, and draws it forwards, whilst with your left hand you grasp that of the other side; with a straight bistoury make an incision, extending from one side to the other, commencing on the free edge of the lip, at a distance from the anterior surface, varying according to the thickness of tissue to be removed; dissect from below upwards, to within a few lines of the frænum of the lip, and when the flap so dissected only holds by its base, cut it away with a scissors or bistoury. There is usually a great flow of blood, but it speedily stops of itself.

By this proceeding you have, as it were, unlined the lip, and produced a wound with loss of substance, which, when healed, leaves only its natural thickness to the lip. No dressing is necessary; only at the end of some days you may apply a slightly compressing band-

age on the anterior surface of the lip to promote the success of the operation.

(3.) *Contraction of the Orifice of the Mouth.*

You may have recourse to all the general proceedings we have pointed out, and it is to the mouth that the proceeding of Boyer is especially applicable. But there is not one at all equal to that of Dieffenbach, which we shall describe with all necessary detail.

Proceeding of Dieffenbach.—The patient being seated on a chair with his head held by an assistant, the first surgeon introduces his left index finger into the mouth, and with it pushes out and extends the right cheek; with the other hand he passes the blade of a well-pointed pair of scissors on the edge of the contracted opening, a little above the commissure; pushes it cautiously from before backwards, between the mucous membrane and flesh of the cheek, to where he wishes to place the labial commissure, and in one cut divides cleanly all that is comprised between the blades of the instrument. A little lower down, but parallel to the first, he makes a second similar incision, and then joins them by a small semicircular incision at their posterior extremity, and so isolates the thin strip, which is cut off without injuring the mucous membrane. The same is performed on the left side in like manner. Then the patient is made to depress his lower jaw, and consequently keep apart the raw surfaces, so as to stretch as much as possible the exposed mucous membrane.

This mucous membrane is separated from the tissues for a little distance all round, and then divided horizontally into two equal portions on each side, to within three lines of the new commissure. The wound must then be well wiped until the bleeding stops; then one of the flaps of mucous membrane is seized, and turned over outwards, until it is in apposition with the corresponding edge of the skin, to which it must be united by very fine points of interrupted or twisted suture: the same thing must be done with each flap, and the portions of the membrane that were not incised near the commissures. The points of suture must be numerous enough to keep the edge of the membrane even when in contact with the edge of the skin, and the wound covered by the membrane as the edge of a shoe by its binding. The after treatment consists in cold applications, incessantly renewed. Reunion generally takes place, almost throughout, by first intention. The threads and needles may be removed on the third or fourth day.

Mr. Campbell has slightly modified this proceeding: instead of making two transverse incisions with the scissors, he used a narrow well-pointed bistoury, which he passed flat in the required direction: when he has pushed it far enough, he turns up its edge towards the skin, and divides it from within outwards, bringing out the point first. M. Serres, of Montpellier, trying *still more to simplify the operation*, divides at once the skin and mucous membrane, and then unites them by suture.

(4.) *Of Hare-Lip.*

Anatomy.—Hare-lip is met with in three different conditions, which singularly modify the operative proceedings. They are distinguished into—

1. *Simple Hare-Lip*, consisting in a congenital fissure of the upper lip, about one-third of an inch from the mesial line, more frequently on the left side than on the right, the cicatrized edges of which present a small reddish portion that must be removed in the operation.

2. *Double Hare-Lip*, in which there are two fissures, separated by a middle flap called the *labial tubercle*, whose form and size much vary.

3. *Complicated Hare-Lip*, in which the two fissures occupy even the anterior portion of the roof of the palate, and unite behind into a cleft that generally divides all the roof and velum of the palate; in this case usually the middle portion of the maxillary bones, or the *osseous tubercle*, much more developed than the rest of the bone, projects considerably downwards and forwards, and is rendered still more prominent by the presence of the incisor teeth, which are cut when the child is born. Sometimes there is also a deviation, that carries the alveolar edge and the teeth directly forwards. In consequence of this projection the *labial tubercle* is pushed forwards, and even becomes attached to the point of the nose.

Lewis has attempted to prove that in hare-lip there is no real loss of substance. This in our opinion is a play upon the words: there is evidently a want of development in the fissure, and you can never expect to have the lip as well formed after the operation as it would be after the reunion of a simple recent wound. Even after the slightest hare-lip, you must always expect that the free edge of the lip will present a little notch, however well the operation has been done; but it is especially the slight projection in the middle of the lip that it is almost impossible to restore when the fissure occupies the median line.

I. **SIMPLE HARE-LIP.** *Ordinary Proceeding.*—The patient should be seated opposite the light, with his head leaning on the breast of an assistant, who embraces the jaw, so as to compress the external maxillary (facial) arteries, pushes the cheeks towards the median line, and holds the lip, if necessary, whilst the operator refreshes its edges. The operator, standing in front of the patient, first seizes the inferior angle of the portion on the left side, either with a hook (Roux), dissecting forceps, or his fingers; and with the other hand passes a strong sharp pair of scissors two or three lines beyond the superior angle of the cleft, with which, in one cut if possible, he removes all the reddish border on this side, encroaching a little even on the healthy tissues, so as to leave a clean, straight, raw edge. For the right side he extends the lip itself, grasping and stretching it, with the left finger and thumb placed outside the edge to be cut off. Then the scissors are used as before, only they ought not to extend so far as the first cut, so as to

leave a neat clean angle of division according to the rules for V incisions. The double incision then represents a V reversed, whose edges should be free from any adhesion to favor reunion. If the frænum of the lip offers any obstacle in this respect, it should be cut without hesitation. This first step finished, you must arrest the flow of blood with cold lotions, and then reunite with the twisted suture. The operator seizes with his left forefinger and thumb the left angle of the cleft; with his right he passes in a needle about three lines from the edge of the wound, and half a line above the natural rosy part of the lip, obliquely from below upwards and from before backwards, to bring it out at the union of the two anterior with the posterior third of the bleeding surface, brings up the other portion on the right side, places it in exact corresponding apposition, and pushes the needle through it from within outwards in the inverse direction. This first needle passes through the tissue with a slight curve, its concavity inferiorly; the object of which is to cause the inferior angles to project a little, and efface as much as possible the notch which the reunion leaves on the free edge of the lip, which is rendered more perceptible still by the consecutive retraction of the cicatrix.*

The first needle being placed, and fixed by a loop of thread, the rest of the division must be brought exactly together with the fingers of the left hand, and a second needle passed through both edges at once at an equal distance from the first, and the superior angle of the wound. The rest of the operation is performed according to the general rules for this kind of suture. The whole must be covered with a bit of lint, and sticking-plaster, and a bandage, which keeps the cheeks forwards, and prevents any muscular strain that might tear the tissues comprised in the points of suture. The patient is then replaced in bed with his head elevated; he should not for the first few days be allowed to speak or move his jaws, a fit of sneezing or laughing will sometimes tear the suture. He should only have fluid diet: after three or four days, if all goes well, you may remove first the lower needle, the next day the upper. The thread adherent to the skin should be left a few days longer; about the ninth or tenth day the cure is usually complete.

A number of modifications of this operation have been proposed. We shall say nothing of refreshing the edges by means of a blister; but the bistoury has had more partisans. It is necessary, in order to use it securely, to place a bit of wood or solid card-board under the lip to cut on, and for this the frænum must be previously divided.

* M. Malgaigne now adopts a very simple proceeding to prevent the formation of this notch. Instead of refreshing the edges from below upwards, he incises them from above downwards, leaving the detached strip adhering by a small pedicle below; he then unites the wound, and, bringing the two little strips over the inferior angle of each edge of the lip, he cuts and trims them to fill up the depression. He forms the central lobule of the upper lip in the same manner, when the cleft is situated in the mesial line. In operating on children, M. Malgaigne passes the needles through the whole thickness of the lips, which does not at all prevent the exact apposition of the raw surfaces; the object of this modification is to guard the wound, and protect it from the tongue in the instinctive motions of suction, during which the tip of the tongue passes through the fissure in the bones, and strikes and licks the wound.—*Gaz. des Hôpitaux*, June 8th.

But the scissors with more facility and promptitude give a neater section. The scissors of Dubois have been generally adopted in France.*

There is only one proceeding in which the bistoury is indispensable: it is when you wish to give a slightly concave form to the edges, so that, when reunion has taken place, there remains a projection at the inferior part that imitates the natural prominence better than the ordinary method. This modification has not been very successful, but perhaps ought not to be altogether rejected.

The modes of reunion have greatly varied. Bandage, sticking-plasters, interrupted and quilled sutures, &c., are now-a-days generally replaced by the twisted suture; only I agree with those surgeons who, instead of two needles, use three. The first should then be placed a little lower, even in the rosy part of the free edge of the lip. I should add also that the bands of sticking-plaster, after the manner of Rigal, seem to me to be of great assistance to the success of the operation. After the incision, in whatever way it may have been performed, the refreshed surfaces present some inequalities which are caused by the different degrees of retraction of the tissues of the lip. We should be aware of this fact, and not try to level the wound by a fresh and useless section.

Proceeding of Mayor.—M. Mayor applies in hare-lip a new kind of suture called, by the mattrass-makers, the quilt stitch (*"le point pique"*).

He uses a double thread, to the end of which, instead of the simple seamstress's knot, he attaches a pellet of cotton, lint, or sponge of the size of a large pea. He does this by making first a simple knot with the end of the double thread, and then doubly knotting the ends over the little pellet. The needle, being thus armed, is first plunged in perpendicularly from *before backwards*, near the left angle of the solution of continuity, on a level with its inferior extremity, and about one line from its anterior border, and brought through the internal or buccal surface of the lip, at the same distance from its angle and free border. The thread is then drawn through until the pellet, which acts the part of a knot, is exactly applied to the little hole made by the needle in its entrance. The same needle is then, in like manner, passed through the angle of the right division, but from *behind forwards*, at the same respective distances as on the left side. The needle having thus traversed the right lip, the loop of thread retaining it is cut, and we have two separate threads passing through the same passage, as in the quilled suture. The ends of the thread are drawn so as to bring the edges of the wound well in apposition; and then, a similar pellet being placed between them, a single knot is made on it, which, as it tightens, pushes the pellet before it, and presses it against the lip to the degree necessary for the approximation of the bleeding surfaces; it is then fixed by a double knot. The inferior angle being thus brought together, for the rest of the wound we may use one or two of the pins used for insects, or one or two points of interrupted suture; or, more

* In England the bistoury seems generally preferred.

simply, some straps of sticking-plaster without any dressing. If, however, the edges of the wound are not perfectly in apposition externally, you might, instead of cutting the thread near the knots, keep on each side an end of sufficient length to cross and tie over a bit of soft lint, and so produce a delicate and soft pressure. M. Mayor advises those operators who are afraid thus to traverse the lip through and through, at all events to substitute the thread and pellets for the needles of the ordinary method.

Appreciation.—The ordinary method perfectly accomplishes its end, so that there is little hope or fear that the method of Mayor will replace it. It is, in fact, nothing more than the quilled suture in a new form, nicely modified, and applied in an operation for which it has been hitherto rejected.

It will be recognized, especially in the second proceeding indicated by M. Mayor; and in each it appears with all its advantages, but also with its well-known inconvenience of causing the wound to gape at its external surface. The author's comparison of it with the "point pique" of the mattress-makers falls, inasmuch as the "point pique" serves to unite surfaces pierced and traversed perpendicularly, whilst in hare-lip it is employed to unite surfaces it does not traverse. The same holds good with regard to the bolts and rivets of locksmiths, also brought forward by M. Mayor. In all these cases, the intermediate band between the two heads or pellets describes a straight line; but in hare-lip M. Mayor causes it to describe a curved line; no comparison can be established.

II. OF DOUBLE HARE-LIP.—Your mode of action depends in a great measure on the size of the tubercle. If it is narrow and projects but slightly, it may be excised without inconvenience; if of considerable size, its preservation is indispensable. Its borders must be refreshed, along with those of the lateral fissures; so that, if it descends to the free edge of the lip, you have two V reversed incisions representing an M. The needles are then placed as usual, bringing perfectly in apposition the lateral edges with those of the middle flap, and traversing all three together. In this manner two parallel linear wounds are obtained, or a Y shaped wound maintained by one range of needles; but if the parallel wounds, or even the branches of the Y, are too far apart, you can apply to each separate points of twisted suture. (Gensoul.)

III. COMPLICATED HARE-LIP.—Some differences in the deformity should doubtless influence the operation; for instance, prominent teeth should be extracted; and the projection of the osseous tubercle in different directions also demands different means of reduction, when it is deemed fit to preserve it; but in general all of those proceedings may be reduced to three, which we shall describe.

Old Proceeding.—With strong scissors, or resection forceps, all the projecting part of the osseous tubercle is removed: then, either immediately, or after some days, the operation is proceeded with as for simple hare-lip. This proceeding leaves a more or less considerable gap in the anterior part of the jaw, and deprives the patient of his incisore heite. After some months another deformity, described by Desault,

comes on. The maxillary bones approximate, and finish by obliterating the cleft in the roof of the palate; but the diameter of the upper jaw, diminished by the breadth of the osseous tubercle, no longer corresponds to that of the lower, and the encasement (*l'emboîtement*) of the upper in the lower jaw, which is seen in old people particularly, and is so inconvenient for mastication, follows. The consideration of this inconvenience, and the facility of the approximation of these bones, led Desault to the following proceeding:—

Proceeding of Desault.—He commenced by applying on the projecting portion a simple bandage, drawn tightly backwards, and fixed on each side. The compression exercised by this band was continued until the parts were quite level; eighteen days sufficed in one case; then he proceeded, as usual, to the reunion of the soft parts; more powerful means may be applied, a spring bandage, &c. In a child of thirteen, where the osseous tubercle presented its alveolar border forwards, Gensoul seized it with strong forceps, as if to break it, and brought it by force to the perpendicular. This bold experiment perfectly succeeded. But this proceeding has another very serious inconvenience. When the labial tubercle is inserted very near the point of the nose, its reunion to the lateral parts draws up the upper lip and leaves exposed the teeth and gums; on the other hand, the nose drawn downwards, flattened and squashed like a calf's muzzle (*Dupuytren*), constitutes a deformity not less than the preceding; whence the idea of making the labial tubercle serve to form the columna of the nose, and reuniting immediately the lateral portions of the lip.

Proceeding of Dupuytren.—The patient placed as usual, the operator divides with a knife the fold of mucous membrane that binds the labial to the osseous tubercle, and, with a sharp-cutting forceps, cuts off all that portion of the latter above the level of the maxillary bones. This first step finished, with a well-pointed bistoury he refreshes the lateral edges of the cutaneous tubercle, then its inferior border; lastly, with sharp scissors, he removes the vertical borders of each lateral portion of the fissure. These two lateral portions are then brought together, and immediately united by two needles, placed as usual. Then the median tubercle, raw on all sides except in front, is folded and applied on the osseous septum of the nostrils. A third needle is put in, compressing at the same time the upper end of each portion of the lip, and the free end of the folded tubercle. Two points of interrupted suture suffice to unite the angles of the tubercle to the lateral portions of the lip. All these sutures are maintained by strapping, and a bandage pressing on the end of the nose to prevent a straining of the flap; a notch cut out of each turn of the bandage embraces the end of the nose, and hinders the bandage from slipping. We have seen this operation crowned with success. The columna being too wide, *Dupuytren* narrowed it by removing a little band on each side with a forceps and scalpel. Gensoul, in a similar case, made the loss of substance of the middle of the columna. The lip is less narrowed than one would have expected; but, notwithstanding the precautions taken to restore to its free edge the median projection, it is replaced by a marked notch, or retiring angle.

Appreciation.—The old proceeding includes all the inconveniences, and should be absolutely rejected; but each of the others has its deficiency also, and neither, in our opinion, should be constituted the general and rational method. We conceive that it is indispensable to combine their advantages—viz., first to level the osseous tubercle by compression, and afterwards use the labial tubercle in the way Dupuytren did. If the teeth are malplaced, they may also be drawn to a better position by compression: if they are of the first set, they may be extracted without inconvenience, to facilitate the operation; but when they are of the second, we should decide on their removal only when the necessity of this sacrifice is absolutely demonstrated, as it not only leaves a deformity, but is a great loss in mastication.

(5.) *Cancer of the Lip.*

Cancer of the lip may be limited to a small tumour, or invade the entire lip, and even the neighbouring tissues. Sometimes it may extend to the maxillary bone. In the first case, cauterization or excision may be resorted to; in the second, the different proceedings of cheiloplasty; to which resection of the bone must be added for the third. We shall speak here of excision and cauterization only.

I. CAUTERIZATION.—The paste of Canquoin, or the arsenical paste, is used. We have already given the general rules for their application; but we must mention here the preparations Dupuytren substituted for the ordinary composition. His *arsenical powder* is a mixture of 4 or 6 parts of arsenious acid with 94 or 96 of calomel: his *arsenical paste*, distilled water ʒj, powdered gum ʒij, calomel ʒj, arsenious acid gr. vj ad xij—rarely more: a larger dose might cause inconvenience.

II. EXCISION. *Proceeding of A. Paré.*—The operator passes a threaded needle through the cancer, so as to be able to raise the tumour with the loop of thread held in his left hand, whilst with a scissors held in his right it is entirely removed down to the flesh. Instead of the needle you can use forceps, or a simple tenaculum. Others seize the lip with the left hand, reverse it, and stretch it conveniently; then, with the scissors of Dubois, comprise the cancer in a V incision, the base of which corresponds to the free border of the lip. The two sides are brought together and united by needles, as in the operation for hare-lip.

Proceeding of Richerand.—It consists in removing the portion affected by a semilunar incision on the edge of the lip, made with a bistoury or curved scissors, which leaves only a slight notch. The wound is simply dressed, and becomes covered with a cicatrix that greatly diminishes its first extent.

Appreciation.—The proceeding of Richerand is only applicable to superficial cancer, diffuse, and on the edge of the lip. The other suits better for circumscribed cancerous tumours with deep roots, especially when they occupy the labial commissures. In these cases, when the cancer sends prolongations into the cheek in different directions, the whole may be removed in several V incisions, combined so that their

edges can always be brought together by suture, and the wound heal by first intention. When the loss of substance is too considerable to be disguised by this method, it is repaired by means of the proceeding of cheiloplasty, which differ for the upper and lower lip.

(6.) *Cheiloplasty for the Lower Lip.*

It was principally for the lower lip, more subject to cancer than the upper, that the following proceedings were imagined; they correspond to the general proceedings of autoplasty. The Indian and Italian methods are not used here, and do not deserve to be. The method of Celsus then remains, which consists in repairing the loss of substance by elongating the neighbouring tissues, without twisting or reversing them; and which constitutes here two different methods, according as we use the integuments of the lip or cheek, or borrow them from the chin or neck—a proceeding that is called the *French Method*.

I. ANCIENT METHOD.—The proceeding most anciently employed is no other than the V incision, applied either to the removal of the cancer or to the refreshing of the edges. The two portions of the wound are then dissected and detached from the subjacent bone, so far that they may stretch and be brought together in the median line, where they unite by suture.

II. FRENCH METHOD. *Proceeding of Chopart*.—In a case of cancer, the surgeon commences by making beyond, and on each side of the diseased part, a vertical incision from the free edge of the lip to below the jaw, longer or shorter according to the extent of the loss of substance to be repaired. He may descend as low as the edge of the os hyoides; seizes the quadrilateral flap, and detaches it from the bone, preserving as much thickness as possible, without scraping the periosteum. The dissection finished, he cuts it across, and removes all the diseased portions. The flap is then drawn up, and the head depressed forwards at the same time; and these two simultaneous movements allow the upper edge of the flap to be brought to a level with the remaining portion of the lip, or to the level of the labial commissures; it is then fastened with three or four points of twisted suture.

Proceeding of Roux of Saint Maximin.—He begins by removing the cancer by means of a semilunar incision, with its concavity upwards. If the disease extends beyond the labial commissures, he prolongs these at the sides, as far as is necessary by transverse incisions that pass above the cancer; and it is at the extremities of these incisions that he commences the indicated semilunar incision, which should in every case embrace all the diseased parts. Their removal being accomplished, the surgeon seizes the edge of his semilunar incision, and dissects, from above downwards, all the soft parts that cover the inferior maxilla, using the bistoury transversely, but more deeply in the median line than at the side. In this way a flap of integuments, like an apron, is obtained with only one free edge; it is detached from the subjacent parts more or less low down, if necessary, as far as the hyoid region. Then the head of the patient is bent forward, and the free border of the flap drawn to the level of the labial commissures. If you have been obliged to prolong these by incisions, reunite the

corresponding edges by suture; the rest should form the border of the new lip. Straps of adhesive, or a suitable bandage, retain all in situ, until perfect reunion takes place.

Proceeding of Lisfranc.—He removes the diseased parts by a semi-lunar incision, as in the last proceeding; but from the middle of this incision he commences another extending vertically as low down as the dissection. He then dissects off the two flaps so as to be able to raise them to the level of the labial commissures, where he unites them by suture. In fact, it is the proceeding of Roux to which a vertical incision is added, dividing his one flap into two.

Appreciation.—The ancient method is certainly much superior in its results. In fact, the lip is formed of the same muscular tissues, and, consequently, susceptible of the same movements as before the operation; it is lined by the same mucous membrane, and is of the same shape. There should then be no hesitation when we can have recourse to it; but when the cancer occupies the entire lip, or even extends beyond the commissures, it is absolutely impracticable, at all events by the ordinary method. It was for these cases that the French method was invented, which gives only a thin, immovable, and deformed lip; but at all events repairs the loss of substance, and prevents the overflow of saliva.

The selection of proceedings is indifferent enough; that of Roux is more difficult, but does not leave any median cicatrix: the difficulty is less in Lisfranc's, and still less in Chopart's: but the number of cicatrices increases in proportion.

It seems to me that we may combine the advantages of the two methods, viz, repair the loss of substance, however large, and obtain a movable lip, by the following proceeding, which is somewhat analogous to the ancient method, and which I was the first to describe.

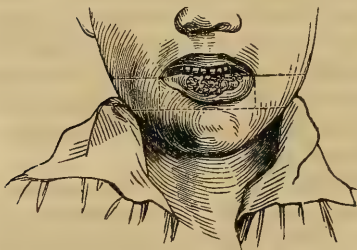
New Proceeding.—All the diseased parts should be first removed, either by a V incision, as in the ancient method, or by two vertical incisions, descending to the base of the maxilla, and there united by a transverse incision.

In the first case you would have a triangular loss of substance; then

you must prolong the angles of the mouth on each side by a transverse incision, and dissect in such a manner as to have two triangular flaps: their vertical edges should be reunited on the median line by points of suture; as to the upper or transverse edge, all that exceeds the extent of the intended lip must also be sewn to the other edge of the horizontal incision.

In the second case, the loss of substance is quadrilateral. To the two incisions that prolong the commissures we must add two others

Fig. 17.



Cheiloplasty for the Lower Lip. New proceeding. Cancer of the lip. The dotted lines represent the incisions to be made—the diseased portion inclosed within the incision is removed—the flaps on each side are dissected up, and then stretched together to be united and fill up the loss of substance.

parallel along the base of the jaw. We can thus, by dissection, detach two lateral quadrilateral flaps, which must be brought together on the median line, and wherever else it is necessary. The last mode of operation is nothing more than the proceeding of Celsus, which has been misunderstood by all his translators; a fact that would prove, if proof were necessary, that to translate a surgical work, it is not sufficient to know the idiom in which it is written, but that it is also necessary to be acquainted with the science of which it treats.

The result of this method is, that the cheeks alone contribute to the formation of the lip, the free edge of which is constituted by the bleeding edge of the horizontal incision. In this way the new lip contains muscular fibres, appertaining to the orbicularis, and its antagonist muscles; it is covered behind by a natural mucous membrane; and you may also cover its free edge with membrane by adopting Dieffenbach's proceeding.

This proceeding, which I described in 1834, has been successfully performed by M. Bonnet of Lyons; but he thinks the sewing of the mucous membrane may be dispensed with, as the progress of cicatrization will spontaneously reunite it to the skin. If the dissected portions cannot be sufficiently elongated, we should have recourse to the semilunar incision of Celsus, by means of which the base of the flap next the ear would be separated from the posterior integuments. In a case in which the inferior maxilla projected excessively, M. Roux resected nearly one inch of this bone; this is a desperate resource, which should not be tried until all others have failed.

(7.) *Cheiloplasty of the Upper Lip.*

Cancer is infinitely more rare in the upper than in the lower lip, so that we have few operations to perform on it, and little is said of it in surgical works. Ledran, having to remove a cancerous upper lip, could find no other way of masking the deformity than by causing the lower lip to remount to the base of the nose. In the first edition of this book, I pointed out, as far preferable, the last method described for the lower lip; since then three beautiful operations of this kind, performed after that method by Lisfranc, Berard, Jun., and Thomas, have given it a real importance. It has been sufficiently described, and we need not recur to it.

(8.) *Genioplasty.*

All the methods of autoplasty have been applied for the restoration of the cheeks; but the proceedings preferred are those of Lallemand, which resemble the Indian, and of Roux, which, properly speaking, is nothing more than the method of Celsus. The loss of substance may affect the cheek only, or encroach on a part of the lips; the proceedings vary slightly in these two cases.

Proceeding of Lallemand.—The edges of the loss of substance being refreshed, the surgeon traces out on the neck the shape of the flap necessary, making it one-third broader than the wound to be covered. This flap should be taken on the side of the neck, below the jaw and in front of the sterno-mastoid; it is then oblique from above down-

wards, and behind forwards; and its pedicle, one inch wide, should be situated near the wound, with which it is continuous by its anterior superior edge. Dissect it carefully, as thick as possible, without touching the external jugular vein, or the branches of the cervical plexus; the dissection finished, turn it gently in the arc of a circle, without twisting its pedicle, and apply it on the wound, which it should completely cover, and to the borders of which fix it by the interrupted suture; then bring the edges of the wound in the neck as close together as possible, in the same manner. Dupuytren applied the Indian method in all its purity, leaving the pedicle completely isolated from the wound, and twisting it on itself. Perhaps there is greater risk of finding the pedicle become gangrenous; and moreover the necessity of afterwards dividing the twisted pedicle, and procuring its cicatrization, is an inconvenience which should cause us to prefer the proceeding of Lallemand.

Proceeding of M. Roux of Saint Maximin.—The edges of the loss of substance are refreshed by means of two semilunar incisions, touching at their extremities, and with their concavities towards each other, so as to form an elliptical wound, almost transverse—the upper and lower edges of the wound are then dissected to a sufficient extent to allow of their being brought together without strain, on being stretched, and they are then united by position, suture, and strapping. This proceeding, already employed by Franco, does not expose to gangrene, leaves only one cicatrix, and forms the new cheek with almost the same tissues as the old; on all these accounts it deserves the preference over the first, excepting when there is so great a loss of substance that a new flap is indispensable to close it up.

(9.) *Immobility of the Lower Jaw.*

This affection presents itself under three principal forms. It is either caused by actual ankylosis, in which case all we can do is to form a passage for nourishment by the extraction of one or more teeth; or it arises from cicatrices inside the mouth, the consequence of badly treated ulceration; or, lastly, whatever be the cause, it is accompanied by loss of substance of the cheek, and then it is necessary to combine with the proceedings we are about to describe those of genioplasty, particularly that of Lallemand.

Division of the inodular constrictions, and the introduction of a wooden wedge between the jaws, to separate them, have been tried: but only a slight separation, which is lost again as the wound heals, is obtained in this manner. Valentine Mott succeeded better by completely dividing the cheek with the cicatrix. Lastly, Mighels modified this proceeding in the following way.

Proceeding of Mighels.—The patient was seated on a chair opposite the light, with his lips held apart and firmly grasped by assistants; the surgeon passed a sharp double-edged bistoury flatly in the direction of the dental arch, to behind the angle of the jaw, and carefully detached from the gums all the abnormal bridles; then turned one of the edges directly outwards to cut across the mass of the cicatrix, as far back as possible. After this section the jaws could be a little separated, and

a small vice was placed between the molar teeth, by means of which they were separated as widely as they could be naturally. The jaws were then kept apart, during the treatment, by means of a bit of wood, and the cheeks kept away from the gums by means of sponges. The operation was thus performed and succeeded on a patient on whom section of the cicatrix had been before tried without success five times. Mighels thought that but slight force would be required to enable him with the vice to separate the jaws; but the force used may be computed as about equivalent to a weight of 100 lbs.

In a case in which the closure of the jaws appeared to be caused by contraction of the levator muscles, Bonnet cut across the masseter and temporal by subcutaneous incision; but with very slight amelioration.

(10.) *Salivary Fistula.*

Two very distinct kinds of salivary fistula are met with—those of the excretory duct of the parotid gland, or Steno's duct; and those of the parotid itself. The first have especially attracted the attention of surgeons.

Anatomy.—Steno's duct, emerging from the parotid at the upper extremity of its middle third, and at its anterior edge, passes from behind forwards; first on the masseter muscle, then about four or five lines in front of this muscle it dips deeply inwards through the adipose tissue of the cheek, pierces the buccinator, and opens without a valve on the mucous membrane, opposite the first or second upper large molar tooth, three or four lines below the point where the buccal mucous membrane is united to the gum. Externally its course is marked by a line parallel to the inferior border of the malar bone, and four or five lines from this border. Its parietes are thick, and it is generally accompanied by the transverse facial artery, and a large branch of the facial nerve.

Fistula of Steno's duct offers important varieties in the choice of the operative proceeding, according as its external orifice is situated in front or behind the anterior edge of the masseter, and according as it is recent or of long standing, wide or narrow, with or without obliteration of the natural orifice.

The proceedings employed may be ranged into four methods. In the first, the sole object is to close the fistulous orifice. By the second, the natural canal is dilated. Third, a new canal, or rather a fresh buccal orifice is established. Fourth, we endeavour to cause atrophy of the parotid gland itself.

FIRST METHOD.—It supposes that the natural orifice is normally permeable, and includes several proceedings.

1. *The twisted suture*, which requires the edges of the fistulous opening to be refreshed, and succeeds well in cases where the canal has been divided by a sabre cut, for instance.

2. *Cauterization*, either with the actual cautery, to produce an eschar that obliterates the opening until cicatrization has taken place, and forces the saliva to pass by its natural canal; or with the nit. of silver when the fistula is narrow, to favour the formation and contraction of inodulary tissue.

3. *Compression*, made either on the fistula itself or on the course of the canal between the fistula and gland (Maisonneuve), or on the parotid itself, to hinder the passage of the saliva during all the time the fistula is closing.

SECOND METHOD. (*Morand.*)—He commences by sounding the fistula with an Anel's stylet, directing it obliquely inwards and forwards, to find the anterior end of the canal, and thus penetrate into the mouth; he passes through this passage a seton made of three bits of thread untwisted to form a *mèche*, and knots on the cheek the two ends. The opening of the fistula he refreshes by means of caustic, and covers with a bit of common adhesive plaster. When he supposes the canal to be sufficiently dilated, he cuts the thread, and draws the seton into the canal, so as to leave only a very short end in the fistula, and none in the external wound.

In the case reported by Morand, twenty-four hours sufficed to obliterate it, and the entire cure only occupied nine days. Louis has remarked that in drawing the seton through, without any precaution, the canal is folded and twisted, and the threads with difficulty pass; he advises us, in order to avoid this little inconvenience, to press gently two fingers of the right hand on the cheek in the direction of the duct, one above and the other below, so as to extend it, drawing them along the cheek from the commissures of the lip towards the ear.

THIRD METHOD.—It has given rise to several proceedings, both for making the artificial opening and hindering it from closing. Deroy traversed the cheek with a heated iron—Monro used an awl—Duphenix a bistoury—Flajani a needle—Desault a hydrocele trocar—Perry an angular awl. In the proceeding of Deroy, the fall of the eschar leaves a sufficiently large opening. Monro placed a seton in it—Duphenix a canula—Percy a leaden wire—Latta a bit of catgut, &c.; but all these foreign bodies are with difficulty maintained *in situ*, unless they are made to traverse the external wound, which hinders the cicatrization. Langenbeck has proposed to dissect out and isolate the posterior portion of the canal, and to conduct it into the interior of the mouth by an artificial opening. This idea is very ingenious; but the dissection would be too long, too difficult and painful to allow of our adopting the proceeding.

Proceeding of M. Deguise.—A small trocar is passed to the bottom of the fistula, and its point directed obliquely backwards, if possible into Steno's duct itself, as near its origin as possible, and the cheek pierced in this direction, either sustaining it inside, two fingers being placed in the mouth, and the trocar pushed between them, or receiving the point of the instrument on a cork, (Richter.) The trocar withdrawn, a bit of lead wire is passed through the canula, which is then taken out. This done, the trocar is again passed into the fistula, but in the opposite direction, and the cheek again pierced, but from behind forwards, and without inwards; the piercer is withdrawn, and a double waxed thread passed through its canula, which may then be removed. This waxed thread serves to conduct the end of the lead wire, left outside into the mouth. There results a loop of wire that embraces the soft parts at the bottom of the fistula; the ends of which, projecting

into the mouth, must be bent on themselves to prevent their displacement; the external wound is healed by the twisted suture; and when perfectly cicatrized, the lead wire is withdrawn by the mouth, leaving two internal openings for the passage of the saliva; or we may wait until it has destroyed the bridge that separates these two openings, and confounded them into one wound. This leaden wire is a metallic seton, which Mirault and Roux advantageously replace by a seton of thread or silk, the two ends of which can be tied in the mouth. As there is some difficulty in passing the seton by the second opening, Grosserio has proposed a trocar, armed with a canula without a rim or lip, so that it can be withdrawn through the mouth. It seems to us much more simple when we resolve on the thread seton to pass it from without inwards, by means of two ordinary needles; and we do not see why, when the fistula is closed, the thread should be left until the intervening parts are destroyed, as there can be no inconvenience from the two openings by which the saliva passes.

FOURTH METHOD.—Desault thought he could produce atrophy of the gland by pressure. Viborg has proposed for the same purpose the application of a ligature on Steno's duct, between the gland and fistula. Several experiments, made on horses, tend to prove that this operation efficaciously remedies the fistula without causing the evils that physiology would lead us to expect. This is a point of sufficient importance to merit further trial.

Appreciation.—You may try cauterization with nitrate of silver when the fistula is very narrow, and gives passage to only a small quantity of saliva. Compression on the wound is of little value; between the fistula and gland, or on the gland itself, it may determine a painful enlargement, examples of which Duphenix and Louis met with. Perhaps it would be a very simple and efficacious method to cover the fistulous orifice with a thin leaf of gold stuck on with pitch; the saliva, arrested by this impenetrable barrier, would perforce take its natural course, and a cure might be expected without any inconvenience. Experience must tell what may be the real value of this simple means.

The second method requires that the anterior end of the canal be open; and its frequent want of success makes it a law never to attempt it but in those persons who absolutely reject puncture of the cheek. But, with these two exceptions, the method by a seton of thread being the simplest, quickest, and surest, should be adopted as a general rule; we would not even except those cases in which the fistula is situated behind the anterior edge of the masseter; it would be easy to pass the needles sufficiently obliquely forwards to avoid traversing this muscle. But if the natural orifice is permeable, nothing hinders us from passing one end of a seton by it, the other being passed through an artificial opening. Whilst the fistula remains uncicatrized, the jaws should remain immovable, so as not to determine a flow of saliva; the patient should keep perfectly silent, and take only liquid aliments.

As to fistula of the parotid gland itself, we employ, with almost equally good results, *cauterization, compression, irritating injections, and excision*, which consists in compressing the ulcer between two

semi-elliptical incisions, which are united by the twisted suture. Extirpation is an extreme resource, to which we have recourse only in cases of absolute necessity.

The same means are applicable to fistula of the submaxillary gland; but here extirpation does not offer the same dangers or difficulties.

(11.) *Extirpation of the Parotid Gland.*

Surgical Anatomy.—The parotid, taken altogether, is shaped in some measure like an irregular pyramid, the oval base of which looks outwards, and the summit inwards. Covered by the skin, and more or less abundant cellulo-fatty tissue, it is exactly bounded above by the mastoid process, the posterior portion of the glenoid cavity, and the temporo-maxillary articulation; behind, it is bounded by the sterno-mastoid, from which it is separated by a very dense fibrous tissue, which serves at the same time as an envelop for the muscle, and a capsule for the gland; below, it extends some lines beneath the level of the angle of the jaw, and is exactly limited by the fibrous capsule which here belongs to it, and separates it from the supra-hyoid region. In front it is less regularly situated; it sends on the masseter some thin prolongations very adherent to the capsule superficially, but easily detached from the muscle on their deep surface. It is narrowed between the sterno-mastoid and maxilla; but inferiorly it plunges beneath this bone and the internal pterygoid which is inserted into it, and stretches forwards almost to the same extent as on the masseter, separated, however, from the pterygoid muscles by its capsule, to which it is but slightly adherent.

Lastly, internally, or by its deep surface, it rests on the following organs. 1. Behind the digastric muscle, on the transverse process of the atlas which raises it. 2. More anteriorly and more deeply the styloid process and the tendons attached to it. 3. More in front, the internal carotid artery. But you must recollect that the gland is separated from all these parts by strong aponeuroses, which aid in the formation of its capsule; for instance, from the digastric, by the enveloping aponeurosis of the latter, which aponeurosis is attached above it to the transverse process of the axis; from this osseous projection to the styloid process is extended a very strong fibrous lamella, which separates the parotid from the internal jugular vein; and from the styloid process the capsule, also very strong, extends in front under the internal pterygoid below, is inserted into the angle of the face, and separates the gland from the internal carotid artery, which is still more separated from it inferiorly by the styloid muscles. I shall also remark that the internal carotid is separated, on this level, from the internal jugular vein, by a very strong fibrous band, that descends from the posterior edge of the carotid foramen. In addition to these relations, so important, the parotid is traversed from below upwards, by the external carotid artery, and the external jugular vein; these two vessels are nearer to the deep surface of the gland than to the superficial; but it is always impossible to remove the gland entirely without injuring them. The first, above this region, divides into its two terminal branches—the superficial temporal, and the internal max-

illary. The vein is formed at the same level by the union of the corresponding veins; but in addition, in the interior of the gland, it gives off a short large branch, which traverses the capsule behind, and joins the internal jugular. We find also, in the thickness of the gland, the origin of the posterior auricular artery, which arises from the carotid itself, and the transverse facial given off by the temporal. The facial nerve runs transversely through the gland, without mentioning some unimportant branches that it receives from the cervical plexus, and inferior maxillary. Lastly, it always contains two or three very small ganglions. It may now be seen how difficult and dangerous is its extirpation; moreover it is rarely extirpated in its ordinary size; generally the disease, that necessitates the operation, has hypertrophied its tissue, and at the same time increased its adhesions with all the neighbouring parts.

Operation.—Many surgeons have begun by tying the common carotid; others put a ligature round it ready to be tied. If these precautions are omitted, at all events an assistant should be ready at hand to compress it, and others to hold the patient firmly, lying on his sound side, so placed that he can breathe and spit freely. The form of the cutaneous incision varies according to that of the tumour; in general, it is better for its direction to be vertical than transverse as regards the great diameter of the gland. The integuments being dissected as usual, the diseased mass is detached, commencing at its upper portion, and then its posterior border. In addition to the parotid being clearly limited in these directions by the temporo-maxillary articulation the inferior wall of the auditory canal, and the mastoid process, you thus avoid wounding the carotid artery in the outset of the operation. As you get deeper in, the edge of the bistoury must be turned more towards the gland than the neighbouring parts which we would preserve: and we should as much as possible substitute for it the handle of a scalpel, with which to tear the adhesions. This part of the operation may be facilitated by making the patient widely open his mouth, which movement removes the condyle from the auditory canal, and so enlarges the space in which the instruments manœuvre. You thus arrive behind the ramus of the jaw, where you must redouble your precaution, on account of the proximity of the external carotid and the origins of the temporal and internal maxillary arteries. If in this part, or more deeply still, there exist any prolongations or processes of the disease which the handle of the scalpel cannot detach, they are tied close to the healthy parts before we excise them with the knife or scissors. By dissecting from above downwards, we at length can turn down the tumour on the neck, and finish detaching it either by tearing, excision, or excision and ligature *en masse*, of the parts that remain to be separated.

In this long and tedious dissection, all the arteries must be tied as you proceed, as soon as they are wounded, unless they are small; in which case they may be compressed by the fingers of an assistant. The arteries that may be wounded are, in addition to the carotids—the transverse facial—the temporal—the auricular—the mastoid—the stylo-mastoid—the occipital—the internal maxillary—the inferior

pharyngeal—the lingual—and the facial. If the external carotid is injured or in danger of being wounded, before proceeding farther, it must be exposed on the side next its origin, and tied. The facial nerve may be cut across boldly as soon as it is perceived. The muscles should be left untouched as much as possible, unless they participate in the disease.

After all the arteries are tied, there often remains considerable venous hemorrhage, which must be stopped by plugging. It is dangerous to attempt union by the first intention, unless the excision is of slight extent, so great a risk is incurred of purulent sinuses, or simple or phlegmonous erysipelas, and all their consequences. There is often, when cicatrization is complete, a difficulty in the movements of the larynx, pharynx, tongue, and even jaw, caused by the division of the styloid muscles; and the section of the facial nerve almost inevitably paralyzes the eyelids, ala of the nose, labial commissure, and corresponding half of the face.

Mayor advises, after having exposed the gland, and isolated all its projecting portion, to traverse it deeply with one or more threads, and tie it in portions; or to draw out the tumour with a hooked forceps, and place a ligature round its root, which ligature he fastens with the *serre-nœud*, as we have explained when speaking of ligature *en masse*.

Velpéau replies that if the disease is deeply situated, this proceeding exposes us to the danger of leaving a portion of it behind; and if it is superficial, the bistoury is less dangerous. But he allows (and we agree with him) that great advantages may be gained from this method combined with ordinary dissection. As to the caustics used by Desault and Chopart, they act so near the great vessels that it is imprudent to use them.

(12.) *Extirpation of the Submaxillary Gland.*

Surgical Anatomy.—Separated from the integuments by the facial vein and platysma muscle, this gland corresponds above to the internal surface of the inferior maxilla, below to the digastric, on the inside to the hyo-glossus and mylo-hyoid muscles. The facial artery bounds its inferior internal side; the hypoglossal nerve and lingual artery pass beneath it; superiorly it receives the plexus of the myloid nerve.

Operation.—It does not differ from the dissection of ordinary tumours. You need only know the position of the nerves and vessels to avoid them, and tie them before you cut them across. It is useful to draw the gland forwards and downwards with a hook; moreover, ligature *en masse* may be very well combined with dissection. Immediate reunion is here less dangerous than for the parotid.

(13.) *Ranula.*

Surgical Anatomy.—This term is applied to a tumour situated under the tongue, projecting into the interior of the mouth sometimes also externally. It is generally attributed to the dilatation of Wharton's duct, although no anatomical fact has been put forward to support this opinion, and the obstinacy of the tumour in re-forming is

directly contrary to it. We think with Dupuytren that, generally, these tumours are nothing more than serous or sero-mucous cysts developed under the buccal mucous membrane.

We shall but mention *incision*, *puncture*, *simple or with a red-hot iron*; the introduction of *tents* or *bougies*, which are almost inevitably followed by relapse; and the *seton*, from which Physick seems to have obtained better success. The two proceedings most generally adopted in France are the *permanent stud* and *excision*.

I. THE PERMANENT STUD.—*Proceeding of Dupuytren*.—This instrument is composed of two elliptical metallic plates, about half an inch wide in their longest diameter, convex on their external, concave on their internal corresponding surfaces, and united in their centre by a solid pedicle a quarter of an inch long. The patient is seated opposite the light, with his mouth widely open. The operator raises with a forceps a portion of the tumour one inch from the point of the tongue, very near where the buccal mucous membrane folds on the inferior surface of this organ, and with a bistoury or curved scissors makes an incision one-sixth of an inch long. He then empties the tumour and puts one head of the stud or double button into it through the incision, the other head resting free in the mouth. If the incision is too large to retain the stud, do not put it in until the next day, when the wound will have sufficiently contracted to hold it firmly. This stud, permanently worn, does not cause much inconvenience: as the liquid is secreted in the cyst, it passes out between the edges of the wound and the shank, and the tumour is thus prevented from reforming.

II. EXCISION.—The tumour being raised with a forceps or hook, commence by making a semilunar incision almost all round its anterior surface; and, seizing the flap thus cut, detach it with a scissors until the floor of the mouth is on a level with the bottom of the cyst. There is scarcely any pain, and a loss of but two or three drops of blood; the wound heals of itself, and without any dressing.

Appreciation.—It should be remarked that Dupuytren invented his permanent stud when he still considered ranula a salivary tumour; and compared its result with that of his lachrymal canula. Excision seems to us more rational. Performed in the way we have described, it is equivalent to extirpation, which is doubtless the surest method for the cure of external cysts. Sometimes, when the ranula extends very far back, it may happen that the borders of the excision retract more than the bottom of the cyst, and threaten to reunite. In a case of this kind I well cauterized the bottom of the cyst with a pencil of nitrate of silver; and retraction having taken place in its entire extent, I obtained a good cure.

(14.) *Section of the Frænum Linguae.*

Surgical Anatomy.—The frænum linguæ, which is called the fillet (*fillet*) when it extends too far on the inferior surface of this organ, or is too narrow from above downwards, is formed of a fold of the mucous membrane only; but, immediately above the part where it is inserted into the tongue, we find the ranine veins covered only by the mucous membrane, and following the direction of the tongue itself.

Operation.—The child should be seated with its head fixed; an assistant pinches its nose to make it open its mouth. The surgeon raises its tongue with his left thumb and index finger, turning the palm of his hand towards the nose of the child, whilst with a pair of scissors he divides the frænum in one cut, carefully directing the point of the instrument downwards, and as far as possible from the tongue.*

If you cannot introduce your fingers without masking the object, use a director. Engage the frænum in the fissure in the handle of the director, raise the tongue, and divide as usual. The wound does not require any precaution, and the movements of the organ prevent reunion. The accidents that may follow are—1. Retroversion of the tongue into the pharynx, observed three times by Petit, and which would stifle the infant if it were not brought forward to its normal position; but this is a rare case.—2. Hemorrhage, when the ranine veins are wounded. You should take care to observe and repress this, as the presence of the blood in the child's mouth causes it to make frequent movements of deglutition and suction, and so promote its flow. It is remedied either by cauterization or by the bandage of J. L. Petit; viz., a fork of wood about one inch long, covered with linen, placed against the symphysis of the jaw and tongue, and fixed by means of a bandage passing out on each side of the mouth, crossing under the jaw, and brought round behind the ears to be tied to the cap of the child; this prevents the tongue from moving.

(15.) *Sublingual Tumour.*

This term is applied to a sort of fleshy excrescence, brown, and very firm, developed under the tongue sometimes so large as to hinder suction. The tongue is raised as in the operation for cutting the frænum, and the excrescence excised with a scissors, always avoiding the ranine veins.

(16.) *Abnormal Adhesions of the Tongue.*

Congenital or acquired, they are met with in the shape of simple bridges, easily divided with the scissors; or intimate cellular adhesions occupying a large extent. The dissection must be proceeded with very carefully, especially near the ranine veins, and the artery, too, placed a little above: generally turning the edge of the knife rather towards the buccal surfaces than to the tongue.

The hemorrhage is arrested by astringent gargles or cauterization. But the greatest difficulty is to hinder the wound from reuniting, and the adhesions from reappearing as before. Frequent motions of the tongue, mild gargles, carefully passing the finger between the raw surfaces pretty often, the application during the night of the bandage of Petit, are the only means we possess. If the edges of the wound, whether of the tongue or mucous surface, are not too far removed from each other, we should have an infinitely more powerful resource in suture, which would unite them by the first intention.

* To avoid the lingual artery.—F. B.

I have left this article as it was in the first editions of this book, to serve for an explanation of an old operation, the indications for which were long since forgotten. You will see in the following, how, after a long digression, modern surgery has returned to this same ancient starting point.

(17.) *Operations for Stammering.*

For the last five years the efforts of operative surgery have been directed towards stammering; and the proceedings and methods for its relief have been multiplied beyond number. Resection of the base of the tongue, resection of its point, simple division with the bistoury or ligature, excision of the tonsils, division of the pillars of the palate, &c. &c.; everything has been tried, and what is still more surprising, almost all these attempts have been brought forward as being eminently successful. Reverses and relapses, however, coming on afterwards, have made surgeons think that perhaps it might be as well to decide, before operating, on what they were doing, and what they wished to effect; for, notwithstanding some deep researches made on this subject, we must confess that the real cause of stammering and its different degrees are unknown; and that surgery has remained quite empirical with regard to it.

It seems, however, that certain forms of stammering are due to a shortness of the attachments of the tongue to the maxilla, whether muscular or fibrous; and on this account we shall describe the operations for destroying these attachments, which seem to be the only proceedings remaining in practice.

Anatomy.—The tongue is connected to the maxilla by the genio-hyo-glossi, by the aponeurosis of the genio-hyo-glossi, and by its proper fibrous membrane. The genio-hyo-glossus muscle, inserted by its apex into the superior genial process, passes backwards, spreading out like a fan, and extends from the base to the point of the tongue. It is flattened laterally so as to present a sharp border above, and is applied against its fellow of the opposite side in the median line; but nearer together in front than behind, where they leave a cellular interval between them. You see then that the farther back you go the more expanded and separated you find them, whence the indication is to divide them as near their genial insertion as possible. Moreover, you have only to divide the mucous membrane and aponeurosis on the floor of the mouth in the median line, and the two sublingual glands at the sides, to expose these two muscles; below, they are in contact with the union of the two genio-hyoid muscles, separated from the skin of the neck by the mylo-hyoid and platysma and slightly on the side by the anterior belly of the digastric.

The aponeurosis of the genio-hyo-glossi is a cellulo-fibrous sheath that envelops them, like all muscular sheaths, and which has consequently the same attachments, and would suffice to retain the tongue forwards, even after section of the body of the muscle. As to the fibrous membrane of the tongue, it is constituted by a very resisting fibrous tissue, placed under the mucous membrane. To expose it well, Bonnet points out the following preparation:—Remove, successively,

the skin of the neck, the platysma, submaxillary gland, the digastric muscles, the mylo-hyoid, genio-hyoid, genio-glossi, hyo-glossi, stylo-glossi, sublingual glands, and lastly, the lingualis muscle, leaving some fleshy fibres still adhering to the fibrous membrane. Then, without opening the mouth, you have the fibrous membrane under your eyes. It is inserted into the lower jaw below its alveolar edge, and to the ligament that unites the angle of the jaw and the extremity of the pterygoid process. From these insertions it passes to line the tongue. Taken altogether, it is nothing more than the fibrous lining of the lingual and buccal mucous membranes, which consequently becomes confounded anteriorly with the submucous portion of the sheath of the genio-glossi. It is remarkable that Amussat, who at first divided the mucous membrane, superior aponeurosis of the genio-glossi, and these muscles themselves, now confines himself almost constantly to section of the mucous membrane and aponeurosis; and that Bonnet, who commenced by dividing the muscle and its inferior aponeurosis, is now obliged to reach the superior aponeurosis and even the lateral portions, which he calls the fibrous membrane of the tongue.

When you operate by the interior of the mouth, you must remember that, passing from the frænum along the lateral attachments of the tongue to the floor of the mouth, we find, under the fibrous membrane, the lingual nerve, with the artery and vein of the same name, and a little lower the hypo-glossal nerve: that in front of the frænum are the orifices of Wharton's duct, close together in the median line; and more in front the two sublingual glands.

I. SECTION OF THE FRÆNUM AND MUCOUS MEMBRANE. *Proceeding of Amussat.*—The patient being seated, with his head thrown back and fixed, cause him to open his mouth widely, and raise his tongue; then seize the frænum with a pair of toothed forceps, behind Wharton's duct. You might imagine that it would be necessary to keep the teeth apart by means of something placed between them, but when the tongue is thrown back, and the forceps fixed under it, instinct obliges the patient to keep his mouth open, to avoid wounding himself. The frænum being thus grasped and raised, cut it across with scissors curved on the flat, like those used for strabismus; one cut divides the mucous and fibrous membranes, and exposes the genio-hyo-glossi muscles. If the section is not large enough, enlarge it on each side, avoiding the attachments of the tongue, and directing the incision to the side of the buccal floor. This is, as you see, the operation recommended long ago for abnormal adhesions of the tongue, to which belong certain varieties of stammering. But that which doubtless made this operation forgotten, is the difficulty of avoiding a return of the adhesions the same as or even stronger than before; the removal of this difficulty is due to Amussat. The object is to hinder retraction of the cicatrix, as we have explained before, when speaking of cicatrices generally, by causing each surface of the wound to cicatrize separately, for which purpose, as soon as the inodular membrane begins to be organized, the commissure that it forms between the two surfaces of the wound in the angle that unites them should be divided each day with a knife until cicatrization is completed.

Moreover, if this section does not sufficiently free the tongue, and you wish to cut the genio-glossi muscles, divide the anterior lip of the section on the median line from behind forwards, throwing on each side the ducts of Wharton and the sublingual glands, without, however, caring much about wounding them.

The edge and two surfaces of the muscles being well exposed, the operator, with a very strong toothed forceps, should embrace both muscles together, plunging his forceps as far forwards and as deeply as possible, and with a long strong flat scissors, cut across the two muscles. This operation has been much performed; it gives rise to an hemorrhage, often alarming, and which has once caused death. It is said that we have no certain guides, and cannot tell exactly where or what we cut; in fact, the indications are anything but precise, and the success always left to chance. If you would cut the genio-glossi from the mouth, the following proceeding seems more simple and less perilous.

II. SECTION OF THE GENIO-GLOSSI. *Proceeding of Baudens.*—The patient, situated as we have said, with his mouth wide open, and the assistant, who fixes his head, placing his two little fingers in the commissures of the lips to draw them backwards, the operator, with a hook, takes up the mucous membrane in the median line, above the edge of the genio-glossi, so as to stretch them, and having recognized the cord they form, he passes the blades of a pair of scissors, strongly bent on the flat, half opened, grazing the maxilla, one on each side of the muscles, to the depth of about one inch, and sharply divides them in one cut. A cracking noise is heard, and the operation is finished. It only occupies a few seconds.

The hemorrhage is not so great here, because the muscles are cut across in a place where there are fewer fleshy fibres, and no vessels so near. In passing the finger into the opening made by the mucous membrane, you meet with an excavation formed by the retraction of the muscles, and recognize the genial processes, and may so find out directly whether there exist still any fibres uncut, which it would be necessary to divide with a button bistoury. The cavity is then plugged with a bit of sponge, rolled up and dipped in vinegar. One of the most remarkable phenomena of section of the genio-glossi is a sharp pain in the ear, and sometimes in the throat, an explanation of which it is difficult to give. When all fear of hemorrhage is passed, the wound heals without inflammation, without accident, and with marvellous rapidity, and even without those vegetations that follow the operations for strabismus, a fact that removes much of our predilection for the subcutaneous section which we are about to describe.

III. SUBCUTANEOUS SECTION OF THE GENIO-GLOSSI. *Proceeding of Bonnet.*—Having determined that stammering often persisted after simple section of the genio-glossi, at their insertion to the genial processes, and even after section of the genio-glossi, and their aponeurosis, M. Bonnet fixed on a proceeding which consists in the successive section. 1. Of the genio-glossi, near the genial processes. 2. Of their lateral aponeurosis. 3. Of the fibrous membrane of the tongue at its

insertion to the jaw. 4. In pushing back the ends of the muscles divided. He uses two instruments, one pointed, the other blunt at its extremity.

The patient being seated, with his head thrown back, the operator, standing in front, commences by passing his left index finger into his mouth above the genial processes. With the pointed tenotome entered immediately under the chin, on the median line, he traverses the skin, the platysma, and the interval that separates the digastric and mylohyoid muscles; then, through this puncture, he passes the blunt tenotome, with its edge turned forwards, until he feels its end under the mucous membrane; then he turns its edge outwards and forwards, so as to cut the genio-glossus on one side, then the same on the other. Each of these steps requires particular precautions. First, to penetrate with certainty on the median line, and at the suitable distance from the chin, he guides himself partly by the interval that separates the two middle incisor teeth, partly by the place where he feels the posterior border of the concavity of the jaw. A still surer guide is the finger, introduced into the mouth, with which the genial process is distinctly felt. This finger placed on the process, and the nail of the thumb on the posterior surface of the concavity of the jaw, fix with precision the place for puncturing. It is quite as important to fix the depth to which the blunt tenotome should penetrate. It is not sufficient to say that it should come just under the mucous membrane to meet the finger, for the finger may depress the membrane even down to the genial processes, and the tenotome being then not deep enough, would not act with certainty on the upper fibres of the muscle, whose division is of the greatest importance. To avoid all error, the tenotome should be pushed to just underneath the membrane, at the spot where it leaves the jaw to form the frænum, and the index finger should feel it all along the space that separates the external incisor teeth. When the tenotome has penetrated deep enough, you should try what its position is in relation to the processes. With this object it should be moved from side to side, its edge being still applied to the jaw; if it feels arrested on each side, you have it well between the processes; if it is arrested only on the right side, it is on the left side of the two processes, and *vice versâ*.

When the position of the muscle has been thus made out, the edge of the instrument should be inclined against it, forwards and to one side. A particular noise, and the feeling of resistance overcome, announce that the muscle is divided. But that the section may be complete, after having worked the instrument with its handle directed slightly forwards, you should cut, holding its handle as much as possible against the neck and backwards. It is only by this manœuvre that the blade can follow the convexity, presented by the jaw from above downwards. To make sure that the section is quite complete, pass the edge of the knife from one side of the processes to the other, until you feel them quite denuded; and as experiments on the subject show that you may move the knife from one side to the other of these processes without dividing the external fibres of the genio-glossi, this movement of the tenotome should be prolonged for two lines beyond

each process. After having cut the genio-glossi, direct the patient to put out his tongue. If he cannot put it out beyond the teeth, the operation is terminated; but if he puts it out beyond the teeth, the aponeurosis of the muscles must be cut at its insertion into the jaw, against which the edge of the instrument is still kept applied: and the muscle be pushed backwards with its flat surface. Again he is told to put out his tongue, and if it still passes the teeth, which proves that the immediate object of the operation is not attained, proceed to detach the fibrous tissue of the jaw. Special care must be taken here not to injure the mucous membrane, and cause the tenotome to penetrate into the mouth, which would bring on an effusion of blood that would interrupt the operation, but the membrane remaining intact, continue to separate the fibrous tissue until the patient can no longer put out his tongue.

It will be seen that to cause an inability to put the tongue outside the mouth is with M. Bonnet the immediate object of the operation, and the proof of its success. This is why he stops after section of the muscles, if that object is attained, and why he carries the sections farther, if the contrary is the case. Nevertheless, there are some subjects, especially those very old, in whom all these sections will not produce this result. In these cases you may predict that the operation is almost or even absolutely useless.

Let us now look at the consequences of the operation. The most important is the formation of an effusion of blood, under the buccal mucous membrane, between the tongue and jaw, forming, on each side of the *frænum linguæ*, a blackish tumour as large as the last phalanx of the thumb. So far, then, nothing is to be feared, and the patient may be allowed to go about the same evening even. In some rare cases, the body of the tongue itself is raised, and there is some hinderance to respiration; but venesection suffices to diminish this difficulty, and on the next day it is probably gone.

M. Bonnet, however, in three cases, has observed a more serious consequence. The entire tongue was elevated, and its point pushed up against the roof of the palate, causing an extreme difficulty in deglutition, and threatening suffocation. This is the result of a more considerable effusion, to avoid which it is essential to hold the edge of the instrument constantly applied against the jaw. A bleeding always produces a prompt amelioration; but when not sufficient, Bonnet passes a thread through the point of the tongue, about two-thirds of an inch from its extremity, in the median line, and with this thread draws the end of the tongue forwards; he says he has always seen the accident diminish the first day, and disappear on the second. Nevertheless, he never operates without having his patient watched for five or six hours after the operation; if no accident comes on during this time, there is nothing to fear. We must not count as an accident the difficulty of deglutition, which remains for two or three days, and depends on the section itself.

Sometimes an abundant salivation comes on, which ceases on the eighth day. Generally the patients may be allowed to set about their work on the third or fourth day; about the eighth the tongue can be

put out a little, and after one month all its natural movements are regained.

(18.) *Cancer of the Tongue.*

Cancer of the tongue shows itself under different forms; sometimes it is a pediculated tumour, and its pedicle may be divided with scissors here as anywhere else.

2. Or it is an encysted tumour, situated in the substance of the organ, adherent to it by a thin cellular tissue only, and easily extracted, after sufficient incision, by enucleation (Dupuytren).

3. Or the cancer is external, confined to the tegumentary layer, which is not at all a rare case; and then the diseased portions only must be removed, by careful dissection, from the sound (Lisfranc).

4. Or the cancerous ulcer occupies but a small portion of the tongue, in which case we circumscribe it by two semi-elliptical incisions, the first below, the second above, and extirpate it; you may also, if necessary, add cauterization to excision, the better to prevent a return.

5. Or, lastly, the disorganization is more deep, and necessitates the removal of a third, one-half, or even the whole of the organ. For these cases, the following proceedings have been proposed.

I. *EXCISION. Proceeding of Lewis.*—When the disease occupies only the anterior part of the tongue, Lewis advises seizing the diseased part with a hook forceps, and completely cutting it off with a bistoury.

Proceeding of Boyer.—The patient is seated on a chair with his head leaning against the breast of an assistant, and a cork between his molar teeth to keep his jaws wide open; the operator standing in front, draws out his tongue and holds it with a simple hook fastened in the diseased portion. He seizes the right edge of the organ between the thumb and finger, and with a pair of straight scissors splits it up in one cut to beyond the tumour, directing the incision so that it may fall as near as possible in the axis of the tongue. The patient is then allowed to spit, the tumour is again grasped with the fingers, and a second incision made with the scissors, joining the first in the median line and cutting off all the diseased portion in a triangular flap. This flap being removed there remains a V-shaped incision in the tongue, which must be reunited by points of interrupted suture; the reapposition suffices to stop hemorrhage. No dressing is necessary. In a case reported by Boyer the cure was accomplished on the eighth day.

Proceeding of Lisfranc.—In a case where a cancerous ulcer occupied the right side of the tongue, near the anterior pillar of the velum palati, which pillar itself participated in the ulceration, the patient being accustomed to draw his tongue outwards and to the left, to him this part of the operation was confided. Lisfranc wished to use a double chain hook, but it seemed better to him, and to me also, to adopt the forceps of Museux. All the disease being in fact thus seized, with a strong straight scissors he began his incision, afterwards using curved scissors, with which he made a semi-elliptical excision, comprising the anterior pillar of the palate. On passing his

finger along the wound he felt a small hard spot in its centre; with the forceps and scissors that also was removed. The wound seemed enormous, but was reduced to very little when the tongue was drawn back into the mouth. The patient spoke with great facility, and said he had not felt any pain whatever. Two pretty considerable arteries bled, but when the tongue was protruded again for them to be tied, they could not be found; there was not even any flow of blood. The excision was more than an inch in extent from before backwards, and appeared much larger when the tongue was drawn outwards and to the left side.

II. LIGATURE. *Proceeding of Mayor.*—It consists in isolating the diseased parts from the organ, by means of a ligature passed with one or more needles through the organ. Thus in a case where half the tongue was to be removed, it was drawn out with a hook, a bistoury was passed through it from above downwards on the median line, and from the frænum to the base; and in bringing it forwards the tongue was found divided into two lateral portions. The diseased half was then embraced in a ligature tightened with the tourniquet of Mayor.

Proceeding of J. Cloquet.—He, in like manner, wishing to destroy the lateral half of a tongue, made a small incision above the os-hyoides, through which he passed a curved needle mounted on a handle, and brought it out in the median line at the base of the tongue, the curve of the needle caused the point to approach the teeth as it was pushed through. This point was furnished with an eye through which were passed two ligatures. The needle was then withdrawn, leaving one end of the ligatures in the mouth and taking the other out of the incision. The needle was again passed through the incision and this time brought out under the frænum linguæ. The two ends of ligature left in the mouth were then passed through its eye and brought out through the wound on to the neck. The four ends were thus hanging outside, and two loops of thread were left in the mouth. The operator tied one on the median line of the tongue, after having made an incision in its point from before backwards, in which to engage the thread, with the other he embraced the diseased side of the tongue, and thus strangled and isolated it entirely from the sound parts.

Proceeding of Mirault of Angers.—He makes along the median line of the neck an incision that descends from one finger's breadth below the chin to the os-hyoides, and penetrates into the interval between the genio-hyoid muscles; then drawing the tongue well forwards with a forceps, he passes a large curved needle through the wound and through the base of the tongue, in the median line, into the mouth; and then replunges it from above downwards through the mouth also, on one of the borders of the tongue, to bring it out again through the wound in the neck. In this way one-half of the tongue is included in a loop of ligature, the ends of which hang from the wound in the neck, and are tightened by means of a "serre-nœud."

In a case where the entire breadth of the tongue was diseased, Mirault first tied one-half in this way, and the ninth day, when the ligature came off, having divided all the parts it embraced, he applied a second in the same way on the other half.

Lastly, Maingault proposes to pass the needle under the tongue, and from below upwards across its base, in the mouth itself, which avoids the wound in the neck.

Appreciation.—It may be seen that not one of these proceedings can be adopted to the exclusion of the others; and that the condition of the disease causes the manœuvres of the operation to vary. As to ligature, the proceedings of Mayor and Cloquet have for object and result to sphacelate the diseased portion; those of Mirault and Maingault only constrict it at its base, and allow the blood to enter it by the adhesions of the tongue to the floor of the mouth and the vessels of the healthy side, so that gangrene does not take place; but nevertheless nutrition is diminished and modified sufficiently to cause the disease to disappear. At all events, in a case reported to the Academie, Mirault fully succeeded.

(19.) *Excision of the Tonsils.*

Cauterization, ligature, and excision have been proposed as remedies for hypertrophy of the tonsils. Excision alone deserves a description. You must bear in mind that the tonsils are in contact by their external surfaces with the internal carotid; but the instrument will always be far enough from it, whilst its blade acts parallelly to the external wall of the mouth.

Operation.—Seat your patient opposite the light, with his mouth kept well open by means of a wedge-shaped cork placed between his molar teeth on the sound side, as far back as possible; an assistant holds down the tongue with a spatula, if it is in the way, and draws the commissure of the lips outwards. Seize the tonsil at its posterior part with a volsellum, draw it out from between the pillars of the palate, and holding the volsellum in your left hand, take a straight, narrow probe-pointed bistoury, covered with lint, to within one inch of its extremity, in your right, and pass it between the volsellum and tongue under the base of the tonsil, beyond its posterior surface; then turn its edge upwards and boldly cut off the gland, with a slight sawing motion, keeping the edge constantly parallel to the external wall of the mouth; withdraw the volsellum, bistoury, and gland all together, and then remove the cork. An acidulated gargle will suffice to arrest the flow of blood, unless where it is excessive, and alarmingly obstinate, when the actual cautery must be used. We may use a simple or double hook; but the gland is not so well fixed, and there is a greater risk of wounding the soft parts in introducing and withdrawing it. It is said, however, in reply, that if it becomes necessary to discontinue the operation it is easier to withdraw the hook than the forceps. Dupuytren preferred the forceps.

Some surgeons would have the incision made from above downwards, to avoid wounding the roof of the palate. Richter, on the other hand, being afraid of wounding the tongue, incises first from above downwards, then from below upwards. In fine, the incision from below upwards has no other advantage than that of not masking the parts by the flow of blood, but the incision from above downwards may be made just as well, if thought best. The double incision of Richter seems to us only to prolong the operation uselessly.

Some have advised, in place of the bistoury, scissors, or even more complicated instruments. The operation is so easy with the bistoury that we cannot see any reason for changing it.

(20.) *Abscess of the Tonsils.*

Operation.—These abscesses are opened with a sharp, straight bistoury, guarded with lint to within half an inch of its point. The mouth being kept open, and the tongue depressed as for excision of the tonsils, the bistoury is directed with the right hand on the nail of the left fore-finger, and its point plunged into the abscess, taking care to direct it from before backwards, or parallelly to the wall of the mouth.

(21.) *Excision of the Uvula.*

Operation.—The patient being seated opposite the light, place a cork between his teeth, and seize the uvula with a polypus forceps; draw it forwards as much as possible, and cut it off with a pair of scissors, blunt-pointed and curved on the flat; curved ones are the best, as the uvula cannot so easily escape them.

M. Lisfranc advises, after having drawn forwards the uvula to carry it towards the right side of the mouth, in order, he says, that the scissors may be placed almost transversely in this cavity, and that the part to be excised, engaged between their branches close to the hinge, may be, without fail, immediately and completely divided. There is doubtless an error in the text; the scissors being held in the right hand of the operator, the uvula must be drawn to the left side of the patient's mouth, in order to engage it between the scissors near their hinge.

(22.) *Cleft Palate.*

Surgical Anatomy.—Congenital division of the velum presents itself under three forms.

1. *Simple*, that is to say, the velum is divided by a median fissure, without loss of substance or division of the roof of the palate, and during the movements of deglutition, we see the two portions approach each other even to perfect contact, by a muscular action which is not easily accounted for. Sometimes the division occupies but a small portion of the velum, and then always its inferior part.

2. *With incomplete division of the roof of the palate*, whether this division only comprises the palate bones, or extends partly on the maxillary bones; always in these cases there is a simple cleft, terminated in front by a rounded angle.

3. *With complete division of the roof of the palate*, then there is a separation, more or less considerable, of the two halves of this roof, and almost always also a double division of the dental arch and lip, as we have described in the article on hare-lip.

Whence we have three kinds of operation, which may, if necessary, be combined one with the other. When there is only a narrow fissure in the velum, we have *staphyloraphy*, properly so called; when this cleft, very much separated, simulates a loss of substance, *staphyloplasty*; and when there is also a loss of substance, real or apparent,

of the roof of the palate, an operation, to which you may give the name of *uranoplasty*, already proposed by some German surgeons.

I. STAPHYLOGRAPHY. *Proceeding of Roux*.—The apparatus consists of, 1. Three rather large flattened ligatures, formed of three or four pretty strong threads. 2. Six small curved needles, flat all along, two being threaded on each ligature. 3. A porte-aiguille. 4. A dressing forceps. 5. A button-pointed bistoury. 6. A very long-handled scissors, whose blades, rather short, are bent at an obtuse angle on one side.

The subject being seated opposite the light, with his mouth open, naturally or kept so by means of a wedge of cork, the surgeon seizes, with a forceps, the right edge of the fissure; holds these forceps in his left hand, and with his right guides into the pharynx the porte-aiguille, armed with a needle, the point of which looks forwards. The point of this needle is brought along the posterior surface of the velum, so as to traverse it from behind forwards, near its inferior extremity, about one-third of an inch from the edge of the fissure; before pushing in the needle, wait until the parts are quiet and still; when it has perforated, make its point project as far forwards as possible, and seize it with a forceps, letting go the catch of the porte-aiguille, and draw it into the mouth, carrying with it the ligature. This is a long and tedious manœuvre, and the patient should be given a few minutes' rest after it; during which he may shut his mouth, spit, or breathe at his ease. Then pass in the same manner the other end of the ligature through the left side of the velum, and leave the two ends hanging out of the mouth. Then place a second ligature above or about on a level with the angle of union of the two sides of the velum, and a third exactly in the middle of the interval that separates the two others.

The ligatures being placed, push the middle portions of them towards the pharynx, out of the way, so as not to cut them in excising the edges of the fissure, and proceed to the second step of the operation. Take hold of the bottom of the left border of the fissure with a ring forceps, and put it in a state of tension favourable to the play of your bent scissors, with which begin to refresh the edges; then with a straight probe-pointed bistoury, placed outside the forceps, with its back turned towards the tongue, and used as a saw from below upwards, detach a strip, half a line in breadth, all along. Take care to prolong this strip a little beyond the angle of union of the fissure, keeping it fixed by the forceps until its division is complete. Do the same on the other side, joining the two wounds to each other at a very acute angle, above the angle of union indicated. It only remains to tighten the ligatures. Begin with the most inferior, with which make first a simple knot; after having sufficiently tightened it by means of the index fingers, seize it with the ring forceps, so that it may not loosen until the next is fastened in the same way. Do the same with the two upper ligatures, producing rather more constriction than would be absolutely required to put the borders in immediate contact. Lastly, cut off the ends of the ligatures.

No dressing is necessary, but the patient should be perfectly silent,

take no meat or drink, and as much as possible abstain from swallowing his saliva, spitting it out as fast as it is produced; and carefully avoid anything that might provoke a cough, laugh, sneeze, or that would cause a strain on the pharynx, or velum palati. On from the third to the fourth day you may remove one or two of the upper ligatures; the inferior should remain *in situ* one or two days more. If reunion has failed above, which often happens when the fissure extends along the roof of the palate, you may either wait for obliteration of the opening, in course of time, or promote it by touching the edges with caustic potash (Roux), or the nitrate of mercury (J. Cloquet).

This proceeding has some inconveniences which it is necessary to point out and avoid.

There are three conditions essential to the success of the first step. 1. That the points of suture be placed at the same height on each side of the fissure. 2. That the intervals that separate them be almost equal. 3. That they be at a suitable distance from the edges of the fissure. If the first condition is not attended to, one side of the fissure will be uneven, and puckered, whilst the other will be stretched. If, on the other hand, the points of suture are too far apart, the edges will gape between them, and reunion, by first intention, be hindered. Lastly, if the threads are too far from the edges of the division, you cannot tighten them enough to bring it into perfect contact without causing too great a strain of the velum, with pain and inflammation that might put a stop to the adhesion; if too near, on the contrary, they tear the soft parts comprised in the thread before union is complete; this is a serious accident, which constitutes one of the most frequent causes of the insuccess of staphyloraphy. You see then the importance of passing the needles through a well-determined point of the velum. This is almost impossible by the ordinary method, which, pushing the needle from behind forwards, hides its point from the operator. The ligature being placed, the edges of the fissure must be refreshed, a very difficult manœuvre in Mr. Roux's method. In fact, whatever care is taken to stretch and carry downwards and inwards each half of the velum palati, you always experience great difficulty in making a clean and level section when you commence with its free edge. The soft parts, not held down by anything, avoid and slip away from the edge of the knife. Sometimes the inferior part of the flap tears, or is entirely cut away before the section has reached the angle of the division. If, in place of a bistoury, you use the scissors, you may cut the threads, an accident which has happened to the most skilful operators. Whence the following proceeding.

Proceeding of A. Berard.—His apparatus is very simple, consisting of a common dressing forceps, a toothed forceps, like that of Graefe, a straight-pointed bistoury, needles three-quarters of an inch long by one line broad, the heel being a little thicker, so as to be held better, slightly curved on the flat side for three-fifths from the point, and pierced with an eye large enough to admit a flattened cord; lastly, some flat cords or waxed threads joined to form a flat riband, half a line wide.

The patient being conveniently placed, the operator seizes and extends the left edge of the fissure with the toothed forceps, held in his left hand; with his right he takes the needle in a dressing forceps, its heel being directed parallelly to the length of the forceps, and its concavity looking towards the free edge of the cleft, and pushes it in from before backwards, on a level with the superior angle of the fissure, about three lines outside its free border, until all its curved portion has passed through the thickness of the velum. This curve of the needle allows its point to be directed backwards and inwards, so that it can be perceived across the fissure. The operator then lets go the free edge of the velum, and with the same forceps that served him for stretching it, seizes the part of the needle that projects backwards; a slight traction backwards, and to the side opposite its entrance, suffices to disengage its heel; then the needle is brought from behind forwards, through the fissure, and out of the mouth, with its thread. In the same way, at the same distance, another needle is passed through the right lip of the fissure. This second needle draws after it a loop of thread, which is detached from it, and through which is passed the deep end of the first ligature. The loop of thread is then withdrawn, and this end of the ligature is brought by it from behind forwards, through the right side of the velum, so that we now have the two ends coming out of the mouth, and the middle forming a loop behind the velum, as in the ordinary proceeding. In the same way, a second and third ligature is put in, according to the extent of the fissure, care being taken to pass each needle about three lines from the free edge of the fissure.

The ligatures being all passed, and their loops depressed, to render the threads almost parallel to the edges of the fissure, and so keep them out of the way of the knife, proceed to refresh the edges. The left edge of the cleft is again seized with the toothed forceps, then the pointed bistoury, held as a pen, is carried to the bottom of the mouth, and plunged through the velum one line above the angle of division, its back being turned upwards; a slight pressure on its edge will now suffice to divide the soft parts cleanly, and remove a strip about half a line thick from all along the solution of continuity. Do the same on the right side, holding the forceps in the right, and the bistoury in the left hand, and making a distinct puncture at the commencement. These two strips are still held at the angle of the fissure. They must then be seized in the forceps, for fear they should fall into the œsophagus or trachea, and prolonged to meet each other at an acute angle. Nothing now remains but to tighten the ligatures.

Proceeding of Smith.—N. R. Smith says that the instrumental apparatus is too complicated, and modifies it thus:—

The only indispensable instrument is a very simple needle, consisting of a steel shank, mounted on a fixed handle, terminated by a point a little broader than that of ordinary needles, and curved from its point in a semicircle of about half an inch radius. Instead of being pierced by an eye, it has, about three lines from its point, a notch in one of its edges down to the middle of the blade directed oblique-

ly inwards and backwards, or towards its handle. The blade is wider in front than behind this notch, so that when the needle traverses the soft parts, the posterior angle of the notch does not offer any obstacle to its passage. The end of a sufficiently long thread is engaged in this notch, and waxed so as slightly to adhere to it.

The patient being conveniently situated, and his jaws held wide apart, the surgeon introduces the needle, and carries its curved portion beyond the fissure, directing its point behind the middle of the uvula. He then brings the point forwards, so as to traverse the uvula from behind forwards. If it does not offer resistance enough, he steadies it with a pair of forceps. As soon as the needle projects enough, that is to say, as soon as you can see the thread, withdraw the needle, retaining the thread with a hook or forceps. The first ligature being thus placed on one side, a second is placed half an inch above it; sometimes you may add a third at a like distance from the second. But Smith advises us to abstain from it, when it is evident that the action of this third ligature in keeping the parts together would be too violent; great irritation would be caused, and you would not only gain no end, but hinder, perhaps prevent, the progress of adhesion in the parts comprised between the two others.

To refresh the borders of the incision, seize the two ends of the ligature placed through the uvula, and with them draw it forwards. This portion of the velum is thus brought into almost an horizontal position, and the operator can easily refresh the edges of the fissure with straight or curved scissors. If you would use a straight button-pointed bistoury, the ligature should be given to an assistant, and yourself seize the internal edge of the uvula with a fine dressing forceps. Take care not to cut the threads; they may be easily avoided by pushing them back from the velum. The operator then passes the ligatures through the other side of the velum, in the way already indicated, and refreshes the corresponding edge of the fissure, but in a different manner. The loop of the first ligature, which is behind the velum, the two sides of which it embraces, should be brought forwards, even out of the mouth. The operator takes hold of the corresponding side of the loop, and the end of thread that belongs to it, and with them draws forward the second side, on which he can now act with the bistoury or scissors, as he did on the other. It remains to tie the ligatures, which is easily done by forming with the two ends of each thread the surgeon's knot, and tightening it by twisting the ends round the second finger of each hand, and passing the two fore-fingers along the threads, drawing the two ends outwards, to tighten the knot. The rest is done as we have described before, only the American surgeon advises us to make our patient eat and drink immediately before the operation.

Appreciation.—The apparent simplicity of the proceedings we have just described causes real embarrassment in practice. First the mouth being about three inches deep, which, at most, is only reduced to about two and a half when the mouth is widely opened, the instruments must be pretty long and very slight, so as not to intercept the view. If scissors are used, M. Guyot has also observed that the scissors,

curved at an angle, have the inconvenience of presenting a kind of heel which, resting on the tongue, elevates the point to a height always equal, and obliges the wrist to be held very high in commencing the incision; consequently he substitutes scissors terminated by a curve very open near the hinge, and rather more marked towards the extremity. But the two great difficulties lie in the placing and constriction of the points of suture. If you carry the needle from behind forwards, the loop is formed naturally; but the surgeon does not see his needle, and runs the chance of making his points further apart on one side than on the other. If you pass them from before backwards, it is difficult to withdraw your needle, and in order to place the loop well, you must use the proceeding of Berard, which, simple and ingenious as it is, causes a loss of time, and manœuvres painful to the patient. All these difficulties have been overcome in the most happy manner by M. de Pierris.

Proceeding of M. de Pierris.—He uses an instrument the description of which would be a little too complicated to give exactly here, but whose action is very simple. Imagine a shank curved at a right angle half an inch from its extremity; at this extremity is a notched ring, in which plays a little steel socket destined to receive the needle. The needle is continuous with a straight shank playing freely on the first in the direction of the socket: it has no eye, but near its point has a notch directed obliquely forwards, or towards its point. A loop of thread is engaged in the ring of the bent shank, and retained by the movable socket which occupies the entire length of the ring. The instrument thus armed is carried on the velum, the curved portion being behind it, the needle in front in sight of the surgeon. The needle, pushed from before backwards, traverses the velum, enters its socket, and pushes it back, so as to leave free the notch in the ring; the loop of thread, being no longer retained, falls into the notch of the needle, which, being withdrawn by the same way, brings forwards with it the entire loop, or one of its ends only, as you wish. The same operation repeated on the other side with the other end of the loop, places the loop of the suture in the best position required. A last difficulty exists in tightening the threads. In fact, operating at such a depth, we sometimes tie too tightly, sometimes too loosely. Very often the first knot becomes loose whilst we are tightening the second. Some surgeons have busied themselves to remedy this. The best instrument seems to me to be that of M. Guyot.

Proceeding of M. Guyot.—His instrument is composed—1. Of a hollow canula six inches long, terminated at its internal extremity by two lateral wings figuring two small pulleys, on which the threads glide. At the other end is a piston moved by the thumb. 2. Of a small forceps with two branches, one of which, five inches long, is entirely concealed in the canula, resting along the piston; the other, very short, is only four lines and a half long, and with a small square end penetrates, with the first, two lines into the canula, when the forceps is open. In this condition, on pressing on the piston, the small branch is disengaged from the canula, and immediately raised by a spring beneath it, and the forceps closes. Its ends are very short,

and shaped like a sparrow's beak, so that a knot tightened between them is not arrested by them, but pushes them open as it is strained tighter.

To use the instrument, place the forceps in the canula, after having opened it, so that it remains open on a level with the two pulleys. The first knot is made outside of the mouth. Each end of the thread is passed on one of the lateral pulleys, then they are seized and made equal with the thumb and index finger of the left hand, which remains immovable. With the right hand the instrument is then carried to the bottom of the mouth, and the knot passes before it to the velum. Then the ends of the thread are gently pulled, to bring the knot close to the fissure. When they are joined and fixed, and you see that they are well placed, press your thumb on the piston. The small branch escapes, and the knot is fixed. Withdraw the canula; the forceps remains. The second knot is in the same way made outside the mouth, and passed like the first, until it is on a level with it; then the threads are gently pulled, the canula being supported. The knot tightens on the forceps, and separates its ends, passing through them to the first. The forceps then drops off itself, and the knot is made.

Without doubt we should not place too great confidence in mechanical instruments for surgery; but when all the art of the surgeon cannot advantageously overcome the contrary dispositions that result from the conformation of parts, necessity makes a law. This is especially applicable here. These instruments have been made with rare precision by Charriere the artist, who has certainly done more for surgery in our time than any other.*

II. STAPHYLOPLASTY.—The ancient method has been used, to which we may also conjoin the proceedings of Roux and Dieffenbach, and the Indian method.

Proceeding of Roux.—After having placed the three ligatures, and

* Mr. Fergusson, in a paper read before the Royal Medico Chirurgical Society, Dec. 10, 1844, states that—after a dissecting he had the opportunity of making of the muscles which operate upon the soft palate in an individual who had both the velum and a portion of the hard palate cleft, and from the consideration of the four different states in which the flaps on each side may be seen on looking into the mouth of a person who has cleft palate, and irritating them in different ways, he has arrived at the following conclusions:—"1st, that the flaps are slightly drawn upwards and to the sides, when the levator palati contracts; 2d, that when the levator palati and palato-pharyngeus act strongly, and together, the flaps are so forcibly drawn from the mesial gap that they can scarcely be distinguished from the sides of the pharynx; 3d, that the flaps are forced together, and the edges come into contact, when the superior constrictor muscle contracts during the act of deglutition; 4th, that the circumflexus palati possesses but a feeble power over the flaps; lastly, the fibres of the palato-glossus were very imperfectly developed in the specimen in his possession. The chief object of his paper is to communicate a novel plan of operating in staphyloraphy, founded on the above investigations, and which he has put in practice with most satisfactory results in two cases, during the last twelve months. The principle of his new proposal is to divide those muscles of the palate which have the effect of drawing the flaps from each other, and widening the gap between them when they contract, so that the stretched velum may be in a state of repose, and the joined edges may not be pulled asunder by any convulsive action of the parts during the process of union. In other words, he advises, as an accessory to the operation of staphyloraphy, the division of the levator palati and palato-pharyngeus muscles; and, if requisite, the palato-glossus."—Reported in the *Medical Times*, Dec. 21, 1844.

refreshed the edges of the fissure as usual, but, to the adherent edge of the velum, he makes with a probe-pointed bistoury a transverse incision through the velum on each side, parallelly to and immediately beneath the edge of the palate bone, and extending a little further than the vertical line formed by the points of suture. This incision divides the entire thickness of the velum. By this means the edges can be brought into contact throughout their whole extent without much strain on the threads.

Proceeding of Dieffenbach.—He makes on each side of the fissure, and at nearly half an inch outside it, a longitudinal incision, which allows a remarkable elongation to the edges of the wound, and closes of itself. You will recognize in this proceeding the incision advised by Celsus in operations on other parts.*

Proceeding of Bonfils.—Derived from the Indian method. It consists in cutting from the roof of the palate a flap of sufficient extent, which must be dissected from before backwards, and twisted on its pedicle, to be fitted by suture to the loss of substance in the velum.

* The following are Professor Dieffenbach's observations on the operation for Cleft Palate, translated from his *Die Operative Chirurgie*, 1845.

The instruments used in stitching the palate are—1. A small fine hook, such as is used in the operation for squint. 2. A small narrow-pointed knife, with an octagonal handle. 3. A long narrow forceps, with toothed extremities. 4. Straight feather-spring palate pliers, provided at their distant extremity with a thick, furrowed, button end. 5. Palate needles and lead wire; the first are half an inch long, flattened, and three-cornered at one end; and at the other round, hollow, and internally provided with a screw, into which the wire can be fixed: the wire must be of pure lead, and new drawn, for old wire is very brittle. 6. A corn forceps (*Kornzange*). 7. A pair of plain curved scissors; and 8. For the closing of small holes in the palate, a small-eared hook and thread-like lead wire.

I. OPERATION FOR CLEFT OF THE SOFT PALATE.—At this operation the patient sits opposite the window, the head being supported by an assistant: he then opens his mouth, draws in his breath, and puts down his tongue.

1. *Incision of the edges.*—The edge of the cleft palate is seized in the middle by putting the hook through it from within outwards; the knife is then pushed through near the hook, and drawing it with a sawing motion upwards and forwards, a strip about the breadth of a straw is removed; the knife is then turned downwards, and the lower part cut off, pulling it away with the hook. The same is done at the other side. The patient is then allowed a little rest, and to wash his mouth with cold water; but he must not gargle, as the palate is too much irritated by it.

2. *The insertion and closure of fastenings.*—If the cleft extends over the whole palate, four or five fastenings are required. The needle is first put in the holder, so that the rounded end fits closely in the furrow while the point projects in a proper manner. The instrument (needle), thus armed, is passed through the cleft, first in the upper part, and the palate pierced through about three lines from its edge, from within outwards, on one side. When the needle appears sufficiently advanced through the palate it is laid hold of by the *Kornzange* in the left hand, and loosened by pressing the spring of the needle-holder; the needle and the wire are then drawn out at the mouth with the forceps: the second needle is then put in the needle holder, and, drawing the wire further out, it is also pushed through the cleft and the palate pierced through on the opposite side, as in the former case, and the needle and wire drawn forward till the centre of the latter comes into the cleft. The ends of the wire, with the needles attached, are then cut off, and the wires twisted together until the edges approach each other a little. This (the twisted ligature) is then turned aside into the corner of the mouth, or the assistant can hold it on the upper part of the cheek. The other three or four sutures are then put in at measured distances, and moderately twisted, by which means the edges are made to approach but not touch each other. The wires are then by degrees twisted more and more, and the coagulated blood of the wound is removed with a small sponge, applied on a forceps; at the tighter twisting together, one side of the wire is supported close to the palate by the forceps, that the soft part be not torn. If the cleft is near closing, the

III. URANOPLASTY. *Proceeding of Roux.*—The ligatures being placed as in staphyloplasty, but not tightened, the operator detaches on a level with the angle of the fissure in the palate, and a little beyond it, and for about a quarter of an inch on each side, the layer of soft parts so as in some measure to lay bare the bones. For this purpose, Roux uses small knives, with long narrow blades, bent on the flat near the point, one sharp on one side, the other on the other. By this means you can bring together not only the velum, but also the soft parts of the roof itself—of course refreshing the edges and adding a fourth ligature above the velum, on the parts detached from the roof of the palate.

Proceeding of Krimer.—To close up an opening in the roof of the palate, Krimer made some lines outside its edges, on each side and from before backwards, an incision comprising the entire thickness of the palatine membrane. After having thus circumscribed two flaps of soft parts, he dissected them, reversed them, brought them towards the median line, and united them by points of suture, which were removed the fourth day. Agglutination was perfect, and the roof of the palate was entirely restored.

Each of these proceedings has some special advantage, and circumstances only must direct the choice. We have only described those that have been already employed. It is easy to conceive that we might apply with quite as good hope of success the general proceedings of Chopart, Lallemant, Lisfranc, &c.

upper ligature is then cut off with a flat bent scissors, about four lines from its insertion, and the double end is twisted closer together with a pliers. The same manœuvre is then performed with the other sutures. Before the wires are finally twisted together, a small piece of sponge is pressed into the space between the sutures, in order to clear off the blood. The wires are then twisted more closely together, till the mucous membrane covers the rings, so that they are scarcely seen; the ends of the wire are then again shortened with the scissors, blunted with pliers, and turned away from the tongue, and the mouth is washed with cold water. This is my mode of treatment of clefts that are not very wide, and whose edges can be joined without much straining; but if the cleft is wide, so that the palate would be overstrained in twisting the wires, the union does not succeed; the stitches would either tear through at once, or ulcerate out in a few days, therefore—

3. *Side incisions are necessary.*—One side of the palate is pierced through with a scalpel, half an inch from the edge, and half an inch from the end of the wound; the velum is then cut through upwards, in a sawing manner, to the bony palate; another incision is made on the opposite side; the blood generally flows copiously, and the mouth must be washed frequently with cold water. The beneficial effect of these incisions shows itself immediately; the still strained palate hangs down lax, like a damp curtain, and the wounds on the sides appear like two oval clefts, which would admit two fingers. The painful and straining sensation which penetrates into the ears also ceases immediately, and the air passes freely in and out through them.

The patient must remain in bed, more in a sitting than a recumbent posture, and the watching of a careful assistant is very necessary; and the mouth must be rinsed from time to time to clear away the mucus, which collects in large quantities, and adheres to the ligatures, to assist which a piece of sponge fixed on a small stick is of use. Only water and mucilaginous drinks should be given to the patient, but not lemonade, because it induces coughing and oxidizes the wire. On the third day the mouth may be washed with lukewarm water, or elder tea, and on the fourth, being assured of its complete adhesion by probing it with a camel's hair pencil, one suture may be removed. The end of the wire is first turned to one side with a forceps, and a piece of the ring which now appears cut out; it is then turned to the other side, and the double twisted end cut off; the remaining portion of the ring may be then removed. On the fifth and sixth days the other sutures may be taken out. Frequently the operation succeeds in uniting the entire cleft.—See *Dublin Journal*, Nov. 1845.

CHAPTER V.

OPERATIONS PERFORMED ON THE THROAT.

SETTING aside the removal of certain tumours which may be developed here as in any other parts, but which do not require any particular precepts, the operations performed on the throat may be classed under two heads—those which affect the air-passage, and those which affect the œsophagus; extirpation of the thyroid gland will be treated of in a separate article.

SECTION I.—AIR-PASSAGES.

(1.) *Catheterism of the Air-Passages.* (Fig. 15, p. 272.)

Catheterism is performed either with the intention of allowing the sound to remain as a passage for the air in certain cases of angina or œdema of the glottis, or for inflating the lungs of asphyxiated persons. The instrument is introduced by the nose or mouth.

I. BY THE NOSE. *Proceeding of Desault.*—A gum-elastic catheter of the largest size is used. It is introduced without its stylet through one of the nasal fossæ to the pharynx. There it bends and turns downwards; continue to push it on and you will perceive it enter the larynx. 1. By the sudden cough and painful tickling the patient experiences, and the spasmodic elevation of the larynx. 2. By the flickering of the flame of a candle held before the opening of the sound. 3. By the resistance felt at the bifurcation of the trachea. If it is in the œsophagus these symptoms are not present, and the sound goes down to the stomach. In this case you must withdraw it and try again. If you cannot manage it with the flexible sound, introduce a properly curved wire into it, which will direct it surely.

II. BY THE MOUTH. *Proceeding of Chaussier.*—The instrument of Chaussier, called the *laryngeal tube*, is a conical silver or copper tube, six or seven inches long, expanded at its head, and with two elongated holes at its small extremity; one inch from this extremity it has a rounded curve, on which is placed a small disc pierced with holes, through which a bit of agaric or leather is fastened on it; by this means the opening of the larynx is exactly closed, and all the air goes directly to dilate the lungs.

The base of the tongue being depressed with the left index finger, the small extremity of the tube is passed behind the epiglottis, and gently pushed into the larynx, until the disc of leather is applied on the opening. The mucus, &c., must be sucked out first, then the even times of inspiration and expiration imitated either with the mouth or a bellows. You may allow the laryngeal tube to remain just as well as the elastic sound; though the elastic sound has this advantage, that it more easily adapts itself to the curves of the parts, and perhaps

contuses them less. It seems to us that it would be preferable to leave its tracheal extremity open, rather than have the openings at the sides. Whatever instrument is used, introduction by the mouth is in every case more simple, safe and easy.

(2.) *Operation for evacuating the Serum in Œdematous Angina of the Larynx.*

Surgical Anatomy.—You must recollect that the larynx, in addition to its superior orifice, offers two constrictions, the first of which we have named *the superior glottis*; the second, *the inferior glottis*, or *glottis*, properly so called; it is between these two constrictions that we find the ventricles of the larynx. That which is called *laryngeal angina*, and *œdema of the glottis*, is never situated on the inferior glottis; it occupies the mucous folds of the superior glottis or mouth of the larynx. You can pass a bistoury to these two parts without inconvenience, whilst if you injured the glottis the voice would become hoarse or perhaps be lost for life.

Operation. (Lisfranc.)—A slightly curved bistoury is used; its blade, long and narrow, is fixed in the handle and guarded with lint, to within one line of its point. The patient is placed with his head on a pillow or against the breast of an assistant, and his mouth as wide open as possible, or even kept open with a cork. The operator passes his left index and middle fingers into the mouth through the isthmus of the fauces, and reaches the swelling formed by the œdema. Then holding the bistoury as a pen he passes it flat along his fingers to the part; when he has reached the larynx its edge is turned upwards and forwards; and its handle being elevated or lowered, as gentle pressure is made with its point, the swelling is thus scarified; two or three incisions suffice, with a little compression, to evacuate the serum. You may make more if you like; only try and make them as far apart as possible, to avoid the effects of an inflammation concentrated on one point.

(3.) *Bronchotomy.*

Under the general name of bronchotomy are included all the operations performed on the trachea or larynx, to afford an artificial passage for the air, or extract foreign bodies. There are four different methods which are named—*Tracheotomy*, *laryngo-tracheotomy*, *laryngotomy*, and *sub-hyoid laryngotomy*.

I. *TRACHEOTOMY. Surgical Anatomy.*—In the space that extends from the cricoid cartilage to the level of the sternum, the trachea, more deeply situated in proportion as we approach the sternum, is covered by—1. the skin; 2. the cervical fascia; 3. the sterno-hyoid and sterno-thyroid muscles, sometimes in contact in the median line, sometimes separated and only covering the lateral portions of the trachea; 4. by the isthmus of the thyroid gland, the breadth and position of which vary; sometimes, in fact, it is not more than one-third of an inch deep, and covers the first ring of the trachea, or the following rings as far as the fifth. Sometimes it is as deep as the thyroid gland itself, and covers all these five rings at once; beneath this isthmus, and on the

same plane, we find a considerable interlacement of veins, and the thyroid artery of Neubauer, when it exists. 5. After having traversed all these tissues, you find a cellulo-fibrous layer, and beneath it the trachea itself. You must not forget that it is crossed below by the brachio-cephalic artery, which in violent struggles rises a little above the level of the sternum. Lastly, in case of foreign body or croup, all the soft parts are often infiltrated with serum or gas, and the veins are more gorged with blood than usual.

Operation.—Lay your patient on his back with his chest raised, and his head thrown back; standing on his right side, grasp and fix the larynx with your left hand, and with a bistoury or scalpel make along the median line an incision from the cricoid cartilage to the sternum. By successive careful divisions cut through the skin and aponeurosis; put aside, if necessary, the sterno-hyoid and thyroid muscles; divide the isthmus of the thyroid gland, and the venous flexus with it, to the extent of one inch, and you expose the trachea. Then make your patient take large inspirations to diminish the venous hemorrhage, and tie all the vascular branches that continue to bleed. It is only when this bleeding is stopped that you can safely open the trachea; do it with a straight bistoury; you may enlarge the opening then with the same, or a button-pointed bistoury or scissors, incising longitudinally and from below upwards, three, four, or five rings of the trachea; then place in the wound either a canula, or a spring forceps whose branches holds its edges open.*

The two principal difficulties of the operation are, the stoppage of the hemorrhage and the expansion of the wound in the trachea. In most of the operations published, it has been necessary to tie five or six vessels. M. Recamier recommends performing the operation in two steps, and not opening the trachea until twelve or twenty-four hours afterwards, so as to be quite sure that the bleeding is stopped. If you open it whilst the blood still flows, the inspiration draws the blood into the bronchi. In such cases you should imitate M. Roux, who, placing his mouth on the wound, sucked out the blood, and saved his patient from certain asphyxia. As to the separation of the edges of the wound, the elasticity of the canal is the only obstacle. One would think that, as the rings do not form a complete circle, their division ought to destroy the tendency they have to come together again, but they are so intimately united to the neighbouring rings by

* Mr. Liston prefers a small scalpel, and makes an incision of one inch and a half or two inches, according to the thickness and length of the neck. His proceeding is as follows:—"The opening is made to extend from immediately below the cricoid cartilage to near the top of sternum, and exactly in the mesial line. The skin and superficial fascia are first divided, the fatty matter underneath is cut through, and the deep fascia is exposed and slit up over the junction of the sterno hyoid muscles; their cellular connections are then separated with the point of the knife; with its handle and with the finger, by which it is ascertained that no stray arterial trunk lies in the way, the fore-part of the trachea is cleared of the loose cellular tissues and congeries of veins; these are pushed downwards, and the isthmus of the thyroid body, if it exists, pushed upwards. The patient is desired to swallow his saliva; the moment is then seized when, by this action, the larynx is elevated and the tube elongated; the point of the knife is entered into the rings with its back towards the sternum, and, by a slight sawing motion, three or four of them are divided upwards and in the middle line."—*Op. Surgery*, p. 411.

the fibrous tissue, that it will not allow them to change their situation or relations. In order to overcome this resistance even with the canula, a very long incision must be made. It has been advised even to remove a portion of the rings. Perhaps we could effect it better by dividing on each side the fibrous tissue that unites the divided rings to those untouched.

Lastly, the situation for the tracheal incision is not unanimously settled on. Velpeau points out the fourth, fifth, and sixth rings, and to enlarge the opening, the third and seventh; anatomy showing that the more we descend the deeper it is, and the nearer to the great vessels, we think it more prudent to include in the incision the first ring.

II. LARYNGO-TRACHEOTOMY. *Boyer*.—The inferior part of the incision interesting the trachea comprises the tissues mentioned above, and especially the isthmus of the thyroid gland, but rarely goes as far as the thyroid venous plexus. Higher up you have only to divide the skin, aponeurosis, cricoid cartilage, and crico-thyroid membrane, across which passes a small artery, which it is well to avoid.

Operation.—The patient and surgeon being situated as for tracheotomy, make an incision through the skin from the inferior border of the thyroid cartilage along the trachea for about one inch and a half. The crico-thyroid membrane being laid bare, you see the artery; push it upwards with your nail, and plunge in your bistoury below it, and thus entering the tube, divide from above downwards the cricoid cartilage, and the two or three first rings of the trachea.

III. LARYNGOTOMY. (*Desault*.)—You have only to traverse the skin and sub-cutaneous fascia, to reach the thyroid cartilage; but beyond this cartilage we find a special disposition—the thyro-arytænoid muscles and chordæ vocales are inserted into the posterior surfaces of the thyroid cartilage at its inferior third, and precisely on the median line.

Operation.—The incision should extend from the os-hyoides to the cricoid cartilage. The crico-thyroid membrane being exposed, depress the artery of the same name with your nail, and plunge in the bistoury immediately above it. Then pass from below upwards, through this opening, either a button-pointed bistoury, or one blade of blunt-pointed strong scissors. The instrument traverses the glottis, and passes in as far as the level of the upper border of the thyroid cartilage; then divide this cartilage in the median line, taking care not to deviate to either side and wound the chordæ vocales.

IV. SUB-HYOID LARYNGOTOMY. (*Malgaigne*.) *Surgical Anatomy*.—Between the os-hyoides and the thyroid cartilage is extended a quadrilateral fibrous membrane, about four-fifths of an inch in depth, the transverse section of which leads straight to the superior orifice of the larynx. The tissues that cover it are—1. The skin, and a very thin layer of subcutaneous cellular tissue. 2. The superficial fascia on the median line, and the platysma laterally. 3. At the sides, the omo-, sterno-, and thyro-hyoid muscles; on the median line, a mucous bursa, a description of which I gave in my *Memoir on the Human Voice*. 4. Lastly, the fourth layer is formed by the thyro-hyoid mem-

brane, some fibres of which go to the tongue and epiglottis, under the name of the glosso-epiglottidean ligament, and behind it the mucous membrane of the base of the tongue and epiglottis. In all this space there are no other vessels than the superior laryngeal vein and artery, which run along the superior edge of the thyroid cartilage, and pass into the interior of the larynx very far back, so that they cannot be reached by the instrument, and sometimes a subcutaneous vein which descends on the median line. The laryngeal nerve follows the course of the artery, and is also out of reach.

Operation.—Make a transverse incision one and a half to one and three-quarters of an inch long, immediately beneath the os-hyoides, along its inferior border. In a second cut, divide the platysma and the internal half of each of the sterno-hyoid muscles; then turning the point of the bistoury backwards and upwards, incise in the same transverse direction the thyro-hyoid membrane, and those fibres of it that go to the epiglottis. You then reach the mucous membrane, which is made to project at each expiration. Seize it with a forceps, and divide it also, either with a bistoury or scissors; then the epiglottis presents itself, pushed into the wound by expiration; retain it with a forceps or hook, and you have the interior of the larynx exposed, where the eye can easily direct the instruments.

Appreciation.—In cases of croup or foreign bodies in the trachea, the choice of the surgeon is limited to the three first methods. Laryngotomy of Desault is the easiest, and incurs the least danger of hemorrhage. It allows the largest opening, but on the one hand exposes to lesion of the chordæ vocales, on which account it should never be tried on women; and on the other, in very old people the ossification of the thyroid cartilage renders it absolutely impossible. Cricotracheotomy wounds more vessels, and it has not been sufficiently seen and observed that section of the cricoid cartilage can hardly assist the opening of the trachea, the elasticity of this ring keeping the borders of the division in contact with so much force that it is almost impossible to keep them apart even with the canula; in any case it is a bad operation. We have intentionally omitted speaking of the division of the crico-thyroid membrane proposed by Vicq-d'Azyr, which can only give too small an opening to be useful. We are not aware that it has ever been tried on the living subject. Tracheotomy remains, which enjoys the just title to preference.

If, on the contrary, there is a foreign body, or some serious affection of the larynx, laryngotomy of Desault, or my proceeding, directly exposes the parts. In addition to the other objections to Desault's operation, it has the inconvenience of leaving a partly cartilaginous wound, whilst the other only divides the soft parts. Moreover, subhyoid laryngotomy, though very easily performed on animals or the dead subject, has not yet been tried on the living patient.

(4.) *Bronchoplasty.*

In a case of fistula between the thyroid cartilage and os-hyoides, Dupuytren gave the wound a longitudinal form, dissected its edges,

and united them by four points of twisted suture, but failed. Velpeau applied the following proceeding.

Proceeding of Velpeau.—He cut a flap, longer than it was broad, on the front of the larynx, reflected it from below upwards, leaving it a pedicle of only one-third of an inch; turned it on its cutaneous surface, which by this means became central or internal; and, lastly, made it into a truncated cone, or rather a portion of a cylinder, which he pushed to the bottom of the wound previously refreshed, traversed all with two needles, and finished with the twisted suture. Reunion took place almost all over; there remained only a small fistulous passage, which yielded afterwards to a fresh point of suture.

This is a happy application of the proceeding of Jameson already described. Perhaps the old proceeding, adopted by Dupuytren, would have had more chance of success, if the wound had been brought together from above downwards, rather than from side to side. The folds of the skin in this part hinder reunion of longitudinal wounds, as I have assured myself on animals, and this fact induced me to make the incision for sub-hyoid laryngotomy transverse. The interrupted suture should then replace the twisted, and perhaps the reunion would be better secured by cutting the two lips of the wound slopingly, the superior at the expense of its external, the inferior of its internal edge.

SECTION II.—ŒSOPHAGUS.

(1.) *Catheterism of the Œsophagus.*

Surgical Anatomy.—The Œsophagus (Fig. 15, *t*, p. 267) is placed behind the trachea, almost on the median line, but slightly inclining to the left as it descends, so that when it is necessary to make an effort to introduce the sound it should be directed slightly to this side. But a more important fact is, that the Œsophagus does not succeed to the pharynx until on a level with the union of the cricoid cartilage and first ring of the trachea; it is at this point that spasm of its orifice generally opposes the introduction of instruments, which spasm it sometimes requires a considerable effort to overcome.

Catheterism is performed through the mouth or nose with an ordinary gum-elastic sound, empty or furnished with a stylet, or with a sound longer and larger, called an *œsophageal catheter*.

I. BY THE NOSE. *Proceeding of Desault.*—The patient being seated, with his head thrown back, the surgeon takes, like a pen, the sound, armed with a curved stylet, its concavity looking downwards; introduces it by one of the nostrils, and pushes it to the middle of the pharynx. Then withdrawing the stylet with one hand, with the other he pushes the sound downwards, so as to make it enter the upper end of the Œsophagus, and pass in it as far as is thought fit.

It is very difficult to introduce by the nostril a sound with a stylet sufficiently curved to reach the Œsophagus; moreover, in the greatest number of cases the stylet is unnecessary. Direct the sound with your eye and even finger, making the patient open his mouth wide; if

it enter the larynx you will easily know it by the signs indicated for catheterism of the air-passages.

Desault advised passing the sound very slowly. It is preferable to follow the precept of Itard for catheterism of the Eustachian tube, and push the instrument as rapidly as possible.

II. BY THE MOUTH.—Depress the tongue with the left index finger, and pass the sound, containing its stylet, beyond the orifice of the œsophagus; then withdraw the stylet, and at the same time push on the sound.

Introduction by the mouth is much the easiest, and should be preferred when the sound is only to be kept in for a short time; for example, to seek for a stricture or a foreign body, or to inject liquids into the stomach, or to empty this organ in certain cases of indigestion or poisoning. We should in this case have a sound thirty inches long, and plunge it into the stomach itself; then, by means of a syringe adapted to its upper extremity, first inject a suitable quantity of liquid to wash out or neutralize the poison, and afterwards suck it all out again with the syringe. If, on the contrary, you wish to leave in the sound, it is necessary that it pass by the nostril; but the proceeding of Desault being often difficult, or even impossible, Boyer imagined the following.

Proceeding of Boyer.—The patient being placed as usual, the surgeon passes into one of the nostrils a Bellocq's sound; the spring having come out into the mouth, a waxed thread is attached to its rounded extremity; it is then withdrawn into the sound, and the sound taken out again. The œsophagus sound is then passed into the œsophagus by the mouth; this sound should be pierced near its open extremity with a lateral eye, into which we make fast the thread coming out of the mouth. The other end of the thread coming out of the nostril is then pulled, and the end of the sound brought with it through the nostril, when it may be fastened with a cord to the patient's cap or head.

This proceeding is very ingenious; we may simplify it by using a common elastic sound, as for ligature of polyp of the nose.

(2.) *Stricture of the Œsophagus.*

Dilatation, cauterization, permanent sounds, in fact, almost all the means we shall describe as used for stricture of the urethra, have been applied to, or proposed for, stricture of the œsophagus.

We may, certainly, with an exploring sound, recognize their situation and extent, but their nature rests doubtful; and it suffices to remember that they may be formed by scirrhus or cancerous disease, by aneurisms, &c, to appreciate the danger of energetic therapeutic means. Repeated catheterism, and if necessary, the permanent sound, are the most prudent means, and in doubtful cases the only ones that should be employed.

(3.) *Foreign Bodies in the Œsophagus.*

Usually these foreign bodies are arrested at the superior orifice of the œsophagus, or at least in its cervical portion. Sometimes, though

without angles and soft—for instance, a mouthful of bread or meat, a fruit-stone, &c.—they are retained by a spasm of the œsophagus, caused by a sudden emotion; at other times they hitch in the sides of the passage, by projections or sharp angles; for instance, splinters of bone, bits of oyster-shell, &c.; lastly, when they have remained in this position for some time, inflammation is added to these other causes of retention, and constitutes the most difficult obstacle to overcome. There are three methods of relieving the patient, propulsion into the stomach, extraction by the mouth, and œsophagotomy.

1. *Propulsion into the Stomach*.—It has been recommended to make the patient swallow oil, water, a mouthful of food, &c. Or to introduce into the œsophagus the stalk of a leek ("*une tige de poireau*") oiled, or a sound, terminated by an enlarged metallic extremity. The best instrument is a common sound or a stick of whalebone, furnished at one end with a bit of sponge, or a ball of cotton, destined to press from above downwards, on the foreign body.

2. *Extraction by the Mouth*.—If the foreign body is arrested in the pharynx itself, we may sometimes extract it with a finger. If deeply engaged, try and make your patient vomit, either by giving him a sufficient emetic or by placing two fingers in his throat. This often fails; in which case we have recourse to instruments of diverse kinds, which may be ranged into three classes. Some seize the foreign body by its upper part, and bring it out by a kind of traction—such, for instance, are ordinary forceps, curved polypus forceps, Hunter's forceps, the forceps with numerous branches, or *gérânorhynque* of Missoux, that of Blondeau, made on the principle of the litholabic forceps, &c. Others are destined to pass below it and act by pushing it upwards; some of these are metallic crochets, whether forming a simple crochet with only one branch (Riviere), a crochet terminated by a button (Stedman), a crochet with a loop made of a double wire of tempered silver, twisted spirally for a shank, and bent back towards the loop like Pellier's elevator of the eyelids (J. L. Petit); metallic rings fixed on a pivot, in a movable manner, to some kind of stick; or, lastly, a kind of umbrella proposed by Baudens, which is pushed into the œsophagus shut up, and opens out when it has reached behind the foreign body, and is pulled back.

The instruments of the third class also bring out the foreign body, by pushing it from below upwards, but they differ from the last in that they do not act especially on it, but they as it were sweep the œsophagus, bringing out all that is above them. For this purpose we use shreds of flax (Delahaye), a bit of shredded lint, a bundle of bristles, but generally a sponge passed beyond the foreign body by means of a catheter stylet, a bit of whalebone or sound, a string of little metal beads (Ollenrotz), or a brass wire; or more simply a strong double thread, if deglutition is easy. It has been advised, in order that the sponge may retain its small size and not expand until it has passed the foreign body, to envelop it in sheep-skin or a bit of sheep's-gut (Quesnay). Petit enclosed it with its whalebone stick in a sound. It is more simple to tie it across with a cord, and to introduce it

quickly. If it swells too much before you reach the foreign body, withdraw it and change the sponge.

Appreciation.—It is plain from the description of these instruments that it is impossible to choose between them. When the spasm of the œsophagus is the only cause of the accident, the foreign body can easily be pushed on into the stomach or withdrawn by the mouth. When it is retained by its angles it is chance alone that makes the efforts of the surgeon successful; all the means may then be tried, commencing with the simplest. When the inflammation is come on we rarely succeed, all attempts increasing the engorgement and contraction of the tissues; the œsophagus at last ulcerates and is perforated. The only resource then is œsophagotomy.

(4) *Œsophagotomy.*

The methods proposed for this operation may be reduced to three.

1. That of Guattani, which seeks the œsophagus between the trachea and sterno-hyoid and thyroid muscles on the left side.
2. That of Eckholt, who makes his incision between the two inferior attachments of the sterno-mastoid.
3. That of Boyer, who makes his incision between the sterno-mastoid and sterno-hyoid.

To this, three proceedings belong.

Boyer incises on the projection formed by the foreign body, and only when that exists. Giraud, followed by Vacca-Berlinghieri, advised the introduction of a common silver sound, or a more complicated instrument, to cause the œsophagus to project. Lastly, M. Bégin performed the operation with success, guided only by the anatomical relations.

Surgical Anatomy.—Leaving on the inside the tracheal system, that is to say, the trachea with its muscles and the thyroid body, we find on each side a triangular space, its apex inferiorly, bounded on the outside by the sterno-mastoid. In the area of this triangle we find the skin, platysma, a loose cellular tissue in which glides the omohyoid; and lastly the cellular sheath that encloses the carotid and internal jugular. Putting aside this sheath from the trachea, we fall on the prevertebral plane of the cervical column, and proceeding from without inwards, the first and only muscular fasciculus met with is the œsophagus. As it deviates slightly to the left it is more easily found on that side; you meet with but one insignificant vascular or nervous branches. The incision should never descend lower than within one or two fingers' breadths of the sternum, to avoid the inferior thyroid artery; nor mount higher than the os-hyoides, for fear of reaching the laryngeal nerve, and lingual or facial arteries, and also because at this height you would fall on the pharynx.

Operation.—The patient should lie on a narrow bed, with his shoulders and breast moderately elevated, his head slightly thrown back and leaning on pillows, and his face inclined to the right. Place yourself at his left side, and an assistant, on whom you can confide, at his right. With a scalpel make an incision through the integuments, parallel to the trachea, in the space that separates it from the sterno-mastoid, and within the indicated limits. Divide successively

the platysma and cellular tissue, and penetrate into the cellular space that separates the trachea from the carotid artery; turn outwards the omo-hyoid, which obliquely crosses the wound (Boyer), or divide it on a director (Bégin). During this part of the operation the assistant, placed on the right hand, draws towards himself the trachea and its dependencies, whilst the operator puts aside the left lip of the division, and with three fingers of his left hand, introduced more deeply, covers and protects the vessels and nerves.

In this way all the extent of the cervical portion of the œsophagus is free and exposed. It is easily recognized by its position behind the trachea and larynx, by its rounded and fleshy surface, and if any doubt still remains, by its contractions and hardness when the patient makes efforts of deglutition. You must then boldly plunge the point of your bistoury into this organ at its left side, parallelly to its axis. An incision, half an inch long, being made into it, some mucosities escape by the wound, and the mucous membrane appears; with a button-bistoury enlarge the opening upwards and downwards, so as to allow of the introduction of your finger or instruments.

There is no rule for the extraction of the foreign body, and you must act according to circumstances. The curved and twice-crossed polypus forceps is the most useful instrument; you should have several, of various sizes.

The wound should afterwards be slightly brought together, but without seeking union by the first intention, on account of the inflammation, suppuration, and even sometimes gangrenous state of the portion of the œsophagus occupied by the foreign body, and to leave a free exit for fluids secreted.

This proceeding, we think, ought to remain in practice as the general method. Moreover, if the foreign body projected externally, this circumstance would only make it still easier; and if, on the contrary, any difficulty were experienced in finding the œsophagus, the employment of a common sound, or of the instrument of Vacca, would assist us in overcoming the difficulty.

SECTION III.—OF GOÎTRE OR BRONCHOCELE.

Goître being operated on only when it has acquired a considerable volume, all the normal anatomical relations will vary according to the case. But in every case its close proximity to the carotids, jugulars, and nervous trunks, and to the trachea, the considerable number of vessels that traverse the gland, and whose volume increases with that of the gland; the proximity of the heart, and the consequent chance of air entering the veins, all these circumstances give great importance to the slightest operation attempted on the thyroid gland in a state of bronchocele, no matter what organic change it may have undergone. Caustics—seton—ligature of the thyroid arteries—extirpation, and ligature *en masse*, have all been advised.

CAUSTICS by themselves are of no use, but conjoined with other means, and especially ligature *en masse*, they constitute an energetic resource. Caustic potash is the best.

THE SETON, proposed by the surgeons of the middle ages, has recently been followed by good results in the hands of Dupuytren; one is passed through each side, or even in each prominent lobe of the tumour, if it presents many.

LIGATURE OF THE THYROID ARTERIES to procure atrophy, or gangrene of the tumour, is not certain enough to compensate the gravity of the operation. You must, in fact, tie the four thyroid arteries, without counting the artery of Neubauer, and even then you are not sure that these will suffice, on account of the anastomoses caused by the disease. Four successful cases, however, are reported. There are some cases in which the development of the tumour causes these arteries to be immediately under the skin; without doubt, in these cases it would be worth while to try ligature, which succeeded with Sir A. Carlisle, and is then not of serious consequences.

EXTIRPATION should be tried only when the tumour, by its size, renders suffocation imminent, or by its nature menaces the life of the patient. The rules are the same as for the extirpation of tumours generally, only that here you must take especial care to tie the arteries, and even veins, as soon as they are divided. From the few examples we possess, this is one of the most frightful operations of surgery; at all events, if recourse is had to it, we should advise joining to it ligature *en masse*.

LIGATURE EN MASSE in the ordinary way, applied with success by Mayor, has the same result as extirpation without most of its dangers. We refer you to our general precepts for this ligature, only, in order to have fewer parts to divide with the thread, you should commence by dissecting the tumour at its base as far as possible, without wounding the vessels; you should apply three or four threads, and remove, with a bistoury, all the parts in which circulation is stopped, and which might putrefy.

But, very recently, Ballard and Rigal de Gaillac have applied the ligature without including in it the skin; in fact, by the subcutaneous method.

I shall try to give an idea of this ingenious proceeding. The goître being very large, they resolved to tie it in three portions, each being strangled with a separate thread.

For this purpose they took two long waxed threads, each armed with three needles, viz., one *straight and cutting* (Fig. 18, *a*) at one end of the thread, the second *round and pointed*, *a* 1, in the middle of the thread which it is to draw, double, across the tumour; the last, *curved and cutting*, *c*, occupying the other end of the thread.

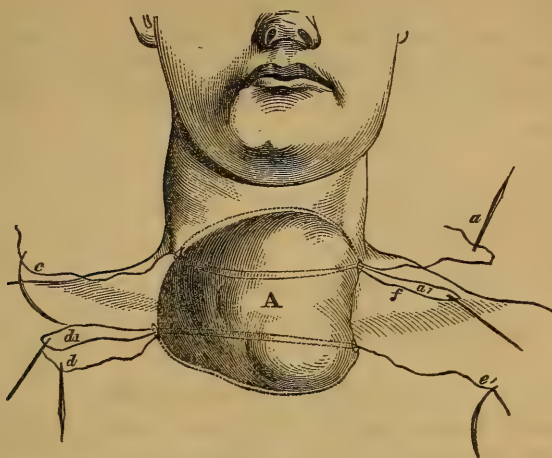
Opposite the superior third of the tumour a vertical fold of the skin was raised, which was drawn strongly upwards, and traversed by the straight needle, *a*, at one end of the thread. The fold of skin being let go, the result was, that the thread described a curve round the upper part of the tumour, and that its two ends hung out by the two lateral punctures, situated on a level with the upper third of the goître.

Through these same punctures, but beneath the tumour, and directly from one side to the other, the round and pointed needle, *a* 1, was

pushed, drawing with it the middle of the thread : when passed it was removed by cutting across the loop.

At this period of the operation, they had then already a complete

Fig. 18.



Represents the mode of ligature applied by MM. Ballard and Rigal de Gaillac;—A, the bronchocele; *a*, the straight-cutting needle, that has been passed through the fold above the tumour, with its thread; *a 1*, one end of the loop carried under the tumour by the round-pointed needle; *d*, *d 1*, the same portions of the second thread; *c* is passed by means of the curved needle, as described, under the skin to the lower puncture on the same side, and then tied to *d 1*; *e* is likewise in the same way passed up to the upper puncture on the same side, and then tied with *f*. Thus we have the superior third of the tumour strangled by *a*, *a 1*; the middle by *c*, *d 1*, and *e*, *f*; and the lower by *d*, *d 1*.

loop surrounding the superior third of the tumour at its base, which loop was entirely under the skin ; its two ends hanging out of the one puncture ; and, moreover, they had a thread passed transversely across, under the upper third of the tumour, and destined for its middle portion. They went through the same manœuvre with the second ligature for the inferior third, and had the same result. It was now only requisite to form round the middle third a complete and subcutaneous loop, with the two threads still isolated, and passed under the tumour.

Each of these threads was still armed with the last needle, the curved cutting one. The upper needle, *c*, was entered from above downwards, in the superior lateral puncture, to be brought out at the inferior puncture of the same side ; and then the two threads, *c* and *d 1*, tightly tied together, were made into only one, and the loop thus ingeniously formed surrounded the middle third of the goitre, above, below, and on one side. The remaining inferior needle was in its turn pushed under the skin from the inferior to the superior puncture to complete the subcutaneous circle ; and they had thus three subcutaneous loops of thread embracing the three portions of the goitre, the two ends of each loop coming out through the same puncture, so that only three punctures remained occupied, and the fourth, left to itself, closed up. The two ends of each loop were passed into a *serre nœud* of

beads, and tied, so that nothing was seen on the exterior but these three strings of beads.

There ensued a febrile reaction, which was combatted by blood-lettings, the fifth day a puncture with a lancet was necessary to give vent to a little pus and gas, accumulated under the skin; there was no other accident. The ligatures, gradually tightened, came away, the middle one on the twentieth day, the inferior the twenty-fifth, and the other some days afterwards; there remained only a trace of the goître, the skin was ulcerated under the beads, but sound everywhere else.

CHAPTER VI.

OPERATIONS PERFORMED ON THE THORAX.

(1.) *Extirpation of the Breast.*

THE rules for this extirpation do not differ from those for extirpation of cancerous tumours generally; though, in consequence of the anatomical relations, and of the importance and frequency of the operation, it has been the object of special researches.

Surgical Anatomy.—The mammary gland rests on the pectoralis major; and usually its greatest diameter is in the direction of the inferior fibres of this muscle. The cancer is also generally elongated in this direction by the consecutive disease of the glands in the axilla, whence the indication for making the longest diameter of the cutaneous incision in this direction.

Operation.—The patient may be seated on a chair; but it is better for her to lie down, either on a bed or a table, with her head and breast raised, and her arm separated from her body so as to extend the skin and pectoralis major. The surgeon stretches the skin below the tumour, and commences by a semi-elliptical incision, with its concavity upwards in the indicated direction; then he passes to the superior incision, so as to comprise in the elliptical flap thus circumscribed all the portion of skin diseased, and even a little of the healthy integuments; or, if the integuments are sound to a great extent, as much is cut away as would be superfluous in covering the wound after the operation; then seize the tumour, and detach it from below upwards, then from above downwards, turning the edge of the knife towards the sound parts, a little of which should always be removed with the disease. You should not hesitate, if necessary, to remove a portion of the pectoral muscles, or even ribs, if the disease extends so far. The rapidity of the dissection renders it unnecessary to tie the arteries before you have finished. If any are larger than usual, the fingers of an assistant may be applied on them.

The tumour being removed, examine with the eye and finger if you have not left any of the diseased or even suspicious-looking parts; and,

if you have, remove them with the knife or scissors. If any axillary glands are diseased, uncover them by prolonging the external angle of the wound to them; or, if far removed, by making a fresh opening; they are almost always situated on the external surface of the serratus magnus; so that, to put out of the way the brachial artery and nerves, it suffices to elevate the arm, and slightly raise it from the trunk; the dissection is then without danger. Moreover, when you fear wounding any rather voluminous vessel, arterial or venous, you may embrace it beyond the diseased parts in a ligature, and divide it below the thread. Reunite with sticking-plaster, and dress as usual.

If afterwards there arise any suspicious vegetation on or near the cicatrix, it should be immediately destroyed with the knife, actual cautery, or caustics. Some surgeons would have the elliptical incision directed from above downwards, others across; others prefer a T incision. Dubois adopted for the dissection a large square-pointed knife. These modifications are of slight importance, and even offer less advantages than the ordinary proceeding; but the following are different. Instead of commencing by dissecting the tumour from below upwards, begin and finish your dissection from above downwards; you thus avoid getting your knife under the inferior border of the pectoralis major.

Lisfranc advises, when the integuments will not well cover the wound, dissecting them back to the extent of an inch or two from the subjacent parts. Martinet de la Creuse had recourse to the autoplasmic methods, in order to cover too large a wound, and obtain reunion by the first intention. Lastly, instead of sticking-plaster, sutures are now preferred. These proceedings may, according to circumstances, be advantageous, and should not be rejected.

(2.) *Operation for Empyema.*

Surgical Anatomy.—A quantity of pus, blood, or serum, collected in the chest, may be circumscribed by adhesions; and in this case should not be opened until it projects externally, at a spot called the place of *necessity*. But if it occupies the entire chest, the opening is made at the place of *election*. This place of election should combine three conditions; it should be in a depending part, and should not expose us to wound the diaphragm, or arterial vessels; with this intent we have been advised to choose any of the intercostal spaces, from the fourth to the eleventh inclusive, counting from above downwards; and generally at the union of the posterior third of the circumference of the chest with the two anterior thirds.

1. It must be remembered that the patient is almost always obliged to sit up in his bed, often even bent forwards; and in this case the lower the intercostal space opened the more dependent will be the wound. If, on the contrary, as sometimes happens, the patient lies almost horizontally, the six last intercostal spaces are almost on the same plane, and either may be operated on without inconvenience.

2. The diaphragm is inserted in front to the xiphoid cartilage, and at the sides by six indigitations to the internal surface and superior border of the cartilage of the seventh rib, to the cartilage of the eighth

and to the internal surfaces of the cartilages, and at the same time to the osseous portion of the four last ribs. You see then that the more inferior the intercostal space, the farther back the incision should be made, to avoid the diaphragm; and as the muscles in the vertebral grooves, and the longissimus dorsi, almost cover the posterior third of the chest; and, on the other hand, the eleventh intercostal space, variable in length according to subjects, does not pass beyond this extent, you would risk falling on the longissimus dorsi muscle and diaphragm both at once.

3. The arteries that may be injured are the external mammary and intercostal, or their branches. The mammary artery descends half an inch outside the sternum, and sends small branches into the intercostal spaces, which do not pass outside the anterior third of the chest. The intercostal, more to be feared, divides into two branches, at the posterior third of the rib. The inferior branch, the smallest, follows the upper edge of the next rib beneath. The other branch, which seems to continue the trunk, is hid in the groove of the rib above, as far as the anterior third of the thorax; at this point it approaches the middle of the intercostal space, but is then so small that lesion of it is of no importance; consequently you more surely avoid this artery by incising the breast at the middle third of its circumference, at an equal distance from each rib; but then, to avoid the diaphragm, you should mount to at least the fourth or third intercostal space, counting from below upwards. It is advised in France to choose the third on the left and the fourth on the right, in consequence of the liver; but this reason does not hold good: in fact, the attachments of the diaphragm are as low down on the right as on the left, and a collection of liquid depresses it as much on one side as on the other. To find the indicated intercostal space, you are advised to count the ribs from below upwards when the subject is thin; but if œdema, or *embonpoint*, hinders this method of exploration, you must either fix your place for incision at six-fingers' breadths below the inferior angle of the scapula, or you apply the patient's hand on his sternum, and incise on a level, with the elbow pushed a little backwards. You will see that these two last indications are liable to error according to the height of the thorax, the length of the arm or scapula, and also even according to the state of elevation of the shoulder and ribs. The first is not at all faithful; and you may easily mistake the eleventh for the twelfth rib. It is more certain in thin subjects to take as your point of departure the last rib that is attached to the sternum, or the last intercostal space that reaches as far as this bone, which is the sixth, counting from below upwards or from above downwards. In fact, in œdematous persons the inferior border of the chest may always be left, and the incision may be fearlessly made three-fingers' breadths above it. Hippocrates penetrated into the chest by trepanning a rib, or divided one of the interosseous spaces with a hot iron or cutting instrument. Now-a-days we only use the bistoury or trocart, which constitutes two methods, each of which has different proceedings.

FIRST METHOD. — THE BISTOURY. *Ordinary proceeding.* — The patient is seated on his bed, inclined a little to the healthy side, with

his arm raised and his body supported by assistants. The surgeon, armed with a straight bistoury, commences by recognizing the place of incision; extends the skin with his left hand, and divides it parallelly to the direction of the intercostal space, a little nearer the lower rib than the upper, to the extent of an inch or so. He raises the upper edge of the wound, and divides in the same direction the adipose or œdematous tissue down to the first muscular layer; there he recognizes with his index finger the exact position of the ribs, and carries on the incision at an equal distance from each, passing his finger after each cut to the bottom of the wound, to see that there is no vessel, increased by the disease, in the way. Having reached the pleura, he either feels evident fluctuation and pushes in the bistoury, or the pleura may be lined by false membranes, sometimes very thick and fibrous, and the incision must be continued with the greatest care. If in this manner the tissue of the lungs, easily recognized by any anatomist, is reached without meeting the liquid, the wound must be explored in every direction with the index finger to recognize fluctuation in some part or other; and this indication, being obtained, directs the incision. If on the other hand no fluctuation is perceptible, the wound must be reclosed and another incision made at another point, where the existence of the sac is less evident.

Lastly, the sac being opened, allow only about half of the liquid to escape, and put a mèche in the wound to keep it open, and favour the gradual exudation of the liquid. Such evacuations may be made at intervals; and, if required, emollient, detersive, astringent, or antiseptic injections made.

Proceeding of Velpeau.—He plunges in the bistoury, held in the second or third position, as far as the pleural cavity, and enlarges the opening in withdrawing the instrument.

SECOND METHOD.—THE TROCART.—*Ordinary proceeding.*—Fluctuation being well recognized, the trocar is plunged in at the place of necessity or of election already pointed out, and the canula is left in, being closed with a cork to prevent the complete evacuation of the liquid. This proceeding, in leaving the canula in the flesh, allows it to vacillate and escape, and the pus may flow out between it and the flesh, and, on the other hand, the air may enter when the cork is withdrawn, to allow the pus to flow out. The proceeding of Reybard remedies all these inconveniences.

Proceeding of Reybard.—He perforates the middle of a rib with a gimlet or a trocar, in order to place in it either a metallic canula, or simply a bit of quill; but to the external extremity of this canula is fixed a soft and flexible tube made of the intestines of a cat, which should be carefully wetted before it is used. The result is, that when the pus presents itself at the tube during an effort, for instance, it finds it always open; and if the air, on the contrary, tends to introduce itself during the movements of inspiration, the wetted tube flattens and forms a kind of valve or sucker impossible to pass. By this proceeding, so ingenious and simple, you have the advantage of leaving the chest always open, without ever allowing the air to penetrate into it.

Appreciation.—When you wish to extract coagulated blood, the canula is not large enough, and incision is indispensable, then the proceeding of Velpeau has the advantage of celerity over the other; and when the liquid projects, as it were, beyond a thinned intercostal space, there is no doubt but it deserves preference. But if the flesh is thicker, and the diagnosis is not so clear, puncture with a bistoury exposes us to injure the lung, and even intercostal artery, without giving the certainty of reaching the sac; the ordinary method, which can only be blamed for its slowness, from its very slowness gains security.

A serious question has been lately raised as to the extent that should be given to this incision; and the conclusion come to from several discussions on the point that took place at the Académie de Médecine was, that most success had been obtained from large openings; nevertheless, I do not think that puncture should be absolutely rejected, especially the proceeding of Reybard: theoretically it offers more advantages and less inconvenience than any other; and already several cases of success have given it, in the hands of its inventor, the sanction of experience.*

(3.) *Wound of the Intercostal Artery.*

From what has been said in the preceding article, you may see that this accident is serious only when it occurs in the posterior third of the intercostal space; moreover, the cases of wound of this artery are less numerous than the proceedings proposed to remedy it.

In the first place, it is very difficult to distinguish the hemorrhage from this artery from that produced by a wound of the lung. The introduction of the finger to feel the jet of blood is almost useless, the finger causing by its pressure a compression on the artery; a card passed to the bottom of the wound, and bent to form a gutter to see from which side the blood escapes, would not indicate more. All this part of surgery has been written from imagination. We shall say almost as much of the therapeutical methods; of ligature of the artery with the rib, by five or six different proceedings, and the instruments of Lottery, Quesnay, Bellocq, &c., most of which have never been applied on the living subject.

If the wound is so large that the artery may be seen, nothing would hinder from tying or twisting it; if it cannot be perceived, and the hemorrhage shows itself only by a jet of blood, recourse should be had to the following method of compression.

The middle of a fine compress should be pushed even into the pleura, and the kind of pouch formed by it should be filled with lint to form a pad inside; on pulling which outwards you would compress,

* It has been suggested by Dr. Fergusson that it might be advantageous to employ the needle for the cure of serous effusion into the pleura, in the same manner as it is employed for the cure of hydrocele and ganglion; that is to say, half a dozen punctures might be made with an acupuncture needle, or grooved needle, through one of the intercostal spaces; and thus the serum might pass through the punctures into the cellular tissue outside the pleura, whence it might be absorbed. The same plan might also be adopted in case of hydrops pericardii and ascites.—*Druitt*, p. 408.

not only the course of the wound, which would suffice to stop the bleeding, but also the artery, against the groove of the rib.*

(4.) *Foreign Bodies in the Chest.*

Foreign bodies buried in the soft parts do not require any special precepts. We shall only mention the case where a portion of sharp blade pushed through a rib, and projecting on the side of the lung, is broken off close to the side so as to leave no purchase to extract it by. Such is the case reported by Gerard, who made an opening in the adjacent intercostal space, and passing his index finger, armed with a thimble, through it, pushed back the foreign body from within outwards. S. Cooper treats this proceeding very sneeringly, and says we should saw and remove this portion of rib; but, notwithstanding his authority, we persist in regarding it as more simple and ingenious.

(5.) *Paracentesis of the Pericardium.*

You may reach the pericardium through three points, 1. Through the fifth or sixth intercostal space. 2. Between the xiphoid appendix and the cartilage of the seventh rib. 3. By perforating the sternum.

1. *Method of Desault.*—He made an incision between the sixth and seventh ribs of the left side, opposite the point of the heart, and divided successively the skin, the interlacement of the pectorali-major, and obliquus externus, and the layer of intercostal muscles; the external mammary artery was consequently left at some distance on the inside. These parts being divided, Desault passed his fingers into the chest, felt a bag full of water, and opened it with a bistoury. He thought he had opened the pericardium, but the patient having died four days afterwards, the autopsy showed it had only been a cyst. However, the pericardium was underneath, and may, doubtless, be very well reached by this proceeding; but it risks wounding the pleura.

2. *Method of Larrey.*—He would have us divide, from below upwards, the space that separates the left border of the xiphoid cartilage from the cartilage of the last true rib; you thus spare the pleura, peritoneum, diaphragm, and internal mammary artery, and reach the lowest part of the pericardium.

* Assalini joins all the best modern surgeons in reprobating the introduction of the preceding contrivances (the above instruments and lint compresses) and extraneous substances into the chest, in order to stop hemorrhage from the intercostal artery. All these methods, he remarks, are calculated to excite a dangerous degree of inflammation in the chest; hence he prefers simply cutting the artery across, so as to allow it to retract; and, if this plan fail, he recommends the wound to be closed. Should the blood find its way into the chest, it is true the consequences will be serious, but not fatal; and, if the symptoms require it, the operation of empyema may afterwards be done. A small quantity of effused blood, however, may be absorbed, and no such proceeding be requisite. —*Manuale di Chirurgia*, pp. 58, 59.

Dr. Hennen says: "Unfortunately we but too often are disappointed in finding the source of the hemorrhage; and here judicious pressure is the only resource. In some very slight cases I have used the graduated compress with success; but, if the sloughing is extensive, nothing but the finger of an assistant, relieved as often as occasion may require, and pressure direct upon a compress placed along the course of the vessel, or so disposed as to operate on its bleeding surface, will be of any avail."—See *Cooper's Surg. Dict.*, p. 127-8.

Method of Skielderup.—He advises us to trepan the sternum a little above the spot where the cartilage of the fifth rib is joined to it; there the two layers of mediastinum leave between them a triangular interval, placed more to the left than right side, and filled with cellular tissue. The base of this triangle is at the diaphragm, and its apex on a level with the fifth rib. Lesion of the pleura is the more easily avoided, because the posterior periosteum of the sternum offers considerable resistance to the trepan. A bit of bone being removed, introduce your finger to feel the fluctuation; make the patient lean forwards, and wait until the pleura is pushed through the opening in the sternum, and then incise it with a long narrow bistoury, guided on the index-finger.

We willingly leave to the operator the choice between these three methods. Perhaps Larrey's deserves the preference. Richerand advised, in order to perform a radical cure, to inject irritating liquids into the pericardium; an operation differently judged, but which seems to us too dangerous unless absolutely necessary.

CHAPTER VII.

OPERATIONS PERFORMED ON THE ABDOMEN.

WE shall arrange these operations under three different heads.—
1. *Effusions, Cysts, and Foreign Bodies.* 2. *Solutions of Continuity of the Intestines.* 3. *Hernia.*

SECTION I.—EFFUSIONS, CYSTS, AND FOREIGN BODIES.

(1.) *Paracentesis Abdominis.*

Surgical Anatomy.—A trocar may be introduced in any part of the abdomen that is only covered by soft parts. But the upper or diaphragmatic is naturally excluded, on account of the thoracic viscera. Puncture by the vagina, rectum, or bladder is too difficult and dangerous. Puncture by the scrotum offers no advantages, and is limited to individuals in whom the tunica vaginalis communicates with the peritoneum. The lateral parietes of the abdomen correspond to adherent parts of the intestines; the right hypochondrium is occupied by the liver, the epigastrium by the stomach; the left hypochondrium by the spleen; the supra-pubic region by the bladder. The most favourable region is then the umbilical zone in almost all its parts. The English surgeons prefer the linea alba. In France we generally choose the middle of a line which would extend from the anterior superior spine of the left ilium to the umbilicus. The patient may thus remain lying on his back, and the liquid is easily directed by the canula.

The development of the womb by pregnancy, or any other cause, and the presence of abnormal tumours, may render operation at this place of election perilous, or even impracticable. Scarpa advises during pregnancy making the puncture in the left hypochondrium a little below the third rib (from the bottom). Ollivier proposes the umbilicus. Velpeau affirms that you may make it anywhere in the left flank. The general rule is to choose the point where the liquid projects most, or where fluctuation is best felt; and in doubtful cases to incise the abdominal wall with the bistoury, layer by layer, to the peritoneum.

Ordinary Proceeding.—The patient is laid on his back, his legs extended, the left side approached to the border of the bed as much as possible. A napkin should be beforehand spread under the loins, and an assistant, placed on the right side, moderately compresses the parietes of the belly with his two hands widely spread out. The surgeon, placed to the left, chooses the situation for puncture, and then plunges in the trocar by a sharp quick blow, placing his fingers on the canula to prevent the instrument from penetrating too far. He instantly withdraws the shank, supporting with his left hand the canula, and directing the liquid into a basin held by an assistant. Whilst the liquid flows out, the first assistant continues the pressure on the belly. The surgeon directs the canula, causing it to follow the retreat of the abdominal parietes. If any obstacle, such as an albuminous flake, or perhaps the pressure of the epiploon, interrupts the flow of the liquid, it should be removed by a probe passed into the canula. When you have evacuated the suitable quantity of liquid, withdraw the canula without at all rotating it, whilst with your left index and middle fingers you retain the skin that would follow it. The wound does not require dressing, but a napkin must be applied as a bandage round the body pretty tight, so as to keep up the pressure previously made on the intestines by the liquid and hands of the assistant, and prevent syncope, which often results from sudden removal of this compression.

This operation is rarely followed by hemorrhage: if, however, it comes on, you may leave the canula in the wound, or replace it by a bit of gum-elastic bougie; or, lastly, comprise all the course of the trocar in a large fold of the soft parts, and compress it a little with your finger and thumb until it ceases to flow.

Proceeding of Fleury of the Val-de-Grâce.—You must first prepare a gum-elastic catheter, of middle calibre, and fit to pass through the canula easily. The puncture being made as usual, the catheter is introduced through the canula into the abdomen to a suitable depth; then the canula is withdrawn, and the liquid escapes through the sound.

This proceeding has several advantages. The sound, soft and flexible, follows the retreat of the abdominal parietes without needing to be held; may be plunged into the parts of the abdomen where the liquid rests; runs less risk of being blocked up, since it offers two orifices in the interior; and better directs the liquid into the vessel. But the greatest is, that it may be left in the wound for several hours without trouble. The liquid, left to itself, gradually escapes; the ab-

dominal parietes gradually retract, without needing the hands of an assistant; and so you avoid syncope, and the precautions taken against it. This proceeding, very simple and ingenious, seems to us to be in most cases destined to supersede the ordinary method.

Some practitioners recommend oiling the instruments, which may facilitate their entry. Some do not empty the abdominal cavity all at once, but on several occasions, which is done very well with the sound of Fleury closed with a cork. Lastly, for the radical cure of ascites, injections of wine, Bristol waters, tar-water, nitric oxide gas, steam of wine, &c.; and Mr. Belmas proposes even to introduce the bag of gold-beater's skin which he has imagined as a radical cure for hernia, withdrawing it when the irritation is sufficient. But this is not the place to discuss these different methods.

(2.) *Hepatic Abscess.—Tumours of the Gall-Bladder.—Hydatid Cysts.*

When hepatic abscess is sufficiently prominent externally to be recognized, the peritoneum that covers the liver has contracted adhesions with the parietal layer, so that you need not fear entering the abdominal cavity. Incision of the abscess is then made as usual, care being taken not to prolong it beyond these adhesions. When the diagnosis is less evident, Recamier proposed to make an exploring puncture with a very fine trocar, or a cataract needle, plunged in briskly and immediately withdrawn, so that the liquid may not escape into the neighbouring tissues after the instrument. This accident is not much to be feared when the liquid is inactive, as in serous cysts or hydatids; but, if you operate on the gall-bladder, the danger is so great as to require considerable reserve in the employment of this means. In these doubtful cases the adhesions may not be so extensive or solid. There are then three proceedings.

1. *Proceeding of Graves.*—All the tissues are incised with the bistoury to within two or three lines of the collection; then the wound is filled with lint. The inflammation that supervenes has the double effect of establishing adhesions if they did not exist before, and of determining the abscess to this point.

2. *Proceeding of Bégin.*—An incision is made down to the peritoneum, and the wound dressed as in the former proceeding; on the third day the adhesions are established, and you may open the abscess with the bistoury without any fear of effusion.

3. *Proceeding of Récamier.*—He applies a sufficient layer of caustic potash on the skin to cause a first eschar of moderate size. At the end of some days, he divides it with the bistoury, and at the bottom of the wound applies fresh caustic; and so on, until the action of the caustic has caused sufficient adhesion of the peritoneum; then he opens the abscess with a bistoury or trocar. When the pus is emptied, as the parietes of the abscess do not collapse, but leave a free access to the air, he substitutes an injection of pine-water, or water charged with medicinal qualities, for the pus.

These three proceedings may be adopted almost indifferently; but doubtless that of Bégin is the most expeditious. It is worth remark-

ing that this surgeon, though he has much blamed the injection of Récamier, has had recourse to them with great success.

The opening of *tumours of the gall-bladder* would require the same precautions. But, in exactly conforming to them, you may see that *cystotomy of the gall-bladder*, proposed by J. L. Petit, and so much blamed by Sabatier, would become a very rational operation, if only the signs of biliary calculus were more certain.

Hydatid Cysts of the belly do not need any other means. You may in fact puncture them with the trocar, the escape of the fluid they contain into the peritoneum causing no harm. But this operation, purely palliative, should be restricted to those of very large size—for example, those of the ovary, of which we shall treat separately.

(3.) *Foreign Bodies in the Stomach.—Gastrotomy.*

When foreign bodies, descended into the stomach, refuse to pass the pylorus, and cause serious accidents, gastrotomy has been advised, and even performed.

Operation.—If the foreign body project, or has already caused abscess, the incision should be made on the projection, in the hope of finding adhesions already solidly formed. In contrary cases, you would make on the linea alba in the epigastric region a longitudinal incision about two inches and three-quarters long. Arrived at the peritoneum, cautiously open it. If the transverse arch of the colon presents itself, gently push it down, and you fall on the anterior surface of the stomach. You may then follow the plan of Bégin for opening cysts; or if the danger is imminent, open the stomach at once as cautiously as the peritoneum, especially avoiding to prolong the incision to its greater or lesser curve, where the coronary arteries are found. Then gastroraphy must be performed by the proceedings we are about to describe.

You would render the stomach more prominent, and facilitate the operation, by causing the patient to swallow fluids. But perhaps you would, by so doing, run a greater danger of effusion into the peritoneum, and of making a wound in the stomach that would not, when it was emptied, correspond to that in the abdominal parietes.

This operation has not yet been well studied. We should prefer the proceeding of Bégin.

No instruments have yet been proposed for seizing foreign bodies in the stomach. But nothing is more easy than the introduction of the straight three-branched lithotritry forceps. It is well known that jugglers introduce much larger straight instruments, merely by throwing back the head so far that the upper dental arch may be almost in a line with the œsophagus.

(4.) *Foreign Bodies in the Intestines.—Volvulus, &c.*

Sometimes foreign bodies arrested in the intestines give rise to an abscess perceptible exteriorly, which may be easily and simply opened. But when they do not project anywhere, and still serious consequences endanger life, some have tried to extract them by an opening in the spot where the pain is felt. The difficulty is the same in case of vol-

vulus, or strangulation of the intestine without hernia, occasioned by some abnormal constrictions of the peritoneum, or any other cause. You have always two misfortunes to dread: firstly, lest you should have been deceived by accidents consequent on peritonitis: secondly, being mistaken in the exact seat of the foreign body, volvulus, or strangulation. You cannot then be too reserved in adopting such an operation.

Operation.—The patient lying down on his back, with his legs and thighs flexed, you would make in the place fixed on an incision three or four inches long, straight or semilunar, longitudinal or transverse; but especially avoiding the epigastric artery. The peritoneum being opened, seek the affected part with your fingers. If there is a foreign body, the intestine should be drawn out, and divided along its convexity; the foreign body should be extracted, and the wound treated in the usual way, as we shall presently describe. In case of invagination, you have only to draw the ends of the intestine away from each other to destroy it, and then immediately put it all back again into the abdomen. If it is a strangulation, you must try and isolate it, so that a bistoury, guarded to within a line or two of its point, may without danger divide the band that surrounds the intestine. The external wound must then be reunited by suture.

(5.) *Cysts of the Ovary.*

Anatomy.—The ovary, when transformed into a cyst, loses all its normal characters, and may acquire an enormous volume. When it requires operation, it generally fills up almost all the cavity of the abdomen, so that you cannot without difficulty decide to which side it belongs; and, in most cases, the linea alba is fixed on as the situation for operations. Sometimes it is a single fibrous cyst, with more or less thick parietes filled with a serous fluid; at other times it is a tumour divided into numerous and considerable cells, having no communication with each other, and often containing liquids of different natures. Sometimes the tumour has contracted adhesions more or less strong, numerous, and extensive, with the different organs of the abdomen; sometimes it adheres by its base only. This base or pedicle comprises the Fallopian tube, the broad ligament, and generally a small portion of the uterus, on which the tumour seems implanted. The artery of the ovary very much developed, and other nameless arteries much enlarged, traverse the pedicle, and forbid thinking of simple and pure excision on account of the hemorrhage. Lastly, you should know that the tumour is generally covered anteriorly by the great omentum, which should be carefully pushed back.

Puncture, incision, excision, and extirpation have been advised.

I. PUNCTURE.—It is performed as paracentesis abdominis, but on the most projecting part of the tumour. It is generally only a palliative means, and must be often repeated; though Ledran says he has seen cases of radical cure by this method. It will be observed that in order that puncture may be useful, the liquid must be thin, and contained in a single sac.

II. INCISION (Ledran).—When the liquid appears thick, and en-

closed in several cysts, Ledran advises incision. A longitudinal incision is made at the most depending part of the tumour, and according to its position on the linea alba or outside the recti muscles; then the cyst is divided in the same direction, and as many of the internal septa as possibly can be reached destroyed; or, if any accident is feared, they may be left, in the hope that suppuration will cause them to break up afterwards. A band of shreaded linen is put in the wound, a tent being substituted for it a short time afterwards; and, lastly, a canula is put in, to allow a free passage for the escape of fluids, and through which injections may be made. In this way the cysts become emptied, their parietes suppurate and collapse. Sometimes there remains a fistula difficult to heal, but not very troublesome: it also boasts of several cases of complete cure.

Proceeding of Galenzowski.—Obliged to have recourse to incision in a case in which the adhesions prevented his trying extirpation, Galenzowski first made a large opening in the sac, which gave exit to but a small quantity of fluid. The fingers introduced by this opening proved that it was composed of numerous cells: the surgeon opened and emptied them all; then he traversed one of the walls of the sac with a thread, which he drew tightly, in order that, by fixing the tumour near the wound in the abdomen, the matter that would flow from it might not fall into this cavity. On the thirty-second day, he found in the dressing a flap of the walls of the cyst, and two others on the fifty-second and sixty-second. The patient went out on the seventieth day, having only a very small fistula.

III. EXCISION.—M. Deneux, in his researches on hernia of the ovary, says he removed the greatest part of one of these organs, and the woman recovered.

Sacchi remarks that in encysted tumour of this organ it has been advised “to excise little by little the parietes of the tumour during the time that it is collapsing, suppuration being promoted;” we do not clearly understand this proceeding, which succeeded once, they say, in the hands of Dzondi, and which was followed by death in two other trials, made by Lizars and Martini.

Moreover, it seems to us that excision of a part of the parietes of the cyst, performed at the same time as the external wound, would not be more dangerous than incision alone, and would have more chance of success. In case you could not remove the entire cyst either on account of the width of the pedicle, or on account of adhesions, excision would be a precious resource, especially as, in case of hemorrhage, we might equally well employ the ligature *en masse* of M. Mayor.

IV. EXTIRPATION.*—We find traces of this operation in divers

* Extirpation of the tumour by means of a long incision from sternum to pelvis, practiced some years ago by Mr. Lizars, and lately revived by Dr. Clay of Manchester. The manner of operating, and the previous and subsequent treatment which Dr. Clay adopted, were as follows:—The night before the operation he gave ten grains of inspissated ox gall, and repeated it in the morning, believing it to have the power of evacuating the alimentary canal, and of dispelling flatulence, with the least possible amount of irritation. The patient being placed comfortably on a table, he severed the integuments from sternum to pubes with one stroke—an incision twenty-four inches long. Then, having carefully cut through the peritoneum at the upper part, sufficiently to introduce

authors; but the first who framed an operative proceeding that he intended adopting was Thédén, and the first who performed it seems to have been M'Dowell.

Proceeding of Thédén.—Thédén having observed, during a post-mortem, that the ovarian cyst was easily detached from the peritoneum, proposed the following operation. An incision should be made in the inguinal region, dividing the integuments and abdominal muscles, care being taken not to wound the cyst; which, according to the author, is outside the peritoneum.

This incision should be dilated sufficiently to allow the fingers to penetrate to the ovary. If any artery bleeds (the crural vessels must on no account be wounded) an assistant should compress it with his fingers, and the operation be continued. After having partly disengaged the sac from the lips of the wound, and emptied it of the fluid it contained, you would finish separating it or drawing it outwards; in fact, it is but slightly adherent to the muscles, and still less to the peritoneum. This done, and after having brought it to the outside, it should be surrounded with a loop of thread, long enough to allow its two ends to hang from the wound; the loop of this thread must be passed as far as the ovary, and if it will not yield to the efforts of the fingers, it should be strangled in the ligature. If the ovary is hardened, you would try to extirpate it with the fingers; if not, you would also pass a ligature round it to insure its destruction. If accidents required it, the ligature might be tightened or loosened. The best mode of anticipating them is, if permissible, to amputate the ovary; then, the sac being removed, it would only remain to heal the wound. This proceeding appears very simple, in cases where the anatomical disposition pointed out by Thédén is met with.

Proceeding of M'Dowell.—The patient lying on a bed or table, the surgeon stands between the thighs, held well apart, and commences his incision in the median line from above downwards, from the umbilicus to within one inch of the pubis, dividing successively the skin and linea alba, without wounding the peritoneum. Having reached

two fingers of his left hand, he passed in a probe-pointed bistoury, and, under the protection of his fingers, divided the peritoneum to the extent of the first incision. The pedicle of the tumour, one of the broad ligaments, was then firmly tied and cut through; but, as it was excessively thick, some of the vessels in it continued to bleed, and required separate ligatures. The hands were now passed round the tumour in search of adhesions; some, that were soft and recent, gave way readily to the slightest touch; but an extensive omental adhesion required to be divided by the scalpel, and a vessel that bled freely was secured. The tumour was then lifted up, and removed. When all bleeding had ceased, the integuments were brought together with nine stitches, and straps of adhesive plaster, and a broad bandage was placed round the body. The subsequent treatment consisted in giving small doses of henbane and morphia when necessary, opening the bowels by clysters, relieving flatulence by introducing a gum-elastic tube, and nourishing the patient with a diet as simple as possible. It may be remarked further, that at the time of performing such an operation, care ought to be taken to have the air of a temperature of 65° or 70°; the incision should be made to diverge a little, so as not to cut through the umbilicus; and if, on examining the tumour, it is found either to be of a different nature from what was anticipated, or to have contracted excessively numerous and wide adhesions, it is better to close the wound quietly, without attempting to extirpate it. In order to bring the sides of the abdomen evenly together, a number of lines may be marked across the linea alba with nitrate of silver before the operation.—*Drumitt*, p. 413.

this membrane, he seizes and raises it with a forceps; then with a bistoury or scissors he gently incises it, and, when an opening is made, he passes the forceps in, and removes all the other parts from the peritoneum, which he then incises so as to admit two fingers, or a director may be used; but it is well, in order that the peritoneum may be better raised, to cause the assistants to compress the sides of the wound. When the index and medius finger can be introduced, they are used to raise the peritoneum, and at the same time protect the subjacent parts; and with a button-bistoury, conducted between the two fingers, enlarge the opening, upwards to the umbilicus, or a little below it, and downwards to near the pubis, in the whole length of the external wound. The tumour then shows itself, covered usually by the great omentum, which is pushed upwards, and its size and connections can then be ascertained in a more positive manner. The important point is to see whether it has other adhesions besides its natural insertion; for this purpose one or two fingers, or the entire hand, may be passed in to explore the circumference of the tumour. When these adhesences are very strong and extensive, it is prudent to give up the operation, and to content yourself with incision of the tumour (A. Smith). If they are narrow and loose, though numerous, pass a ligature round each, and then divide them (M'Dowell). When none exist, or when they are destroyed, plunge a bistoury into the tumour, and incise it largely to empty it.

The tumour then becomes small, and its base may be explored. Examine where it is implanted, and recognize its connections with the uterus, the Fallopian tube, and broad ligaments, if any parts remain recognizable. These organs generally form the pedicle of the tumour, which is implanted on one of the sides of the uterus, but in a very variable manner.

When all these circumstances are ascertained, whilst an assistant puts aside the intestinal mass, covered with a compress, and draws out the tumour, reduced to one or several empty cysts, the operator takes a ligature needle, threaded with one or two threads, as required, or rather strong cords.

If the pedicle is small, he passes the needle round it, and includes it in one ligature. If too large, the needle is passed through it, armed with a double thread, and each half is tied separately. The ligatures being tightened, and secured by two knots, cut off one end of the thread, and leave the other hanging out of the wound. Then cut off the entire mass of the tumour to within three-quarters of an inch of the ligatures, leaving enough of the cyst to prevent the ligatures from slipping off. The liquids and blood effused into the abdomen must be carefully sponged out, and the edges of the external wound united by five or six stitches, not comprising in them the peritoneum, and leaving at the lower part an opening as a passage for the ligatures of the portion of cyst, which they should detach, and bring away. Add some straps of adhesive, and a little dressing over all. It has been advised to lay the woman on her belly after the operation, to favor the escape of blood and fluids; this position is troublesomé, and does not seem more necessary than after supra-pubic lithotomy.

It sometimes happens that hemorrhage comes on after the dressing, generally owing to a slip of the ligature. The suture must, in this case, be cut, and the wound reopened, and a fresh "ligature *en masse*" put on, or the base of the tumour be again traversed, to put on several ligatures. Ligature of the vessels, once attempted by M'Dowell, cannot be accomplished.

In his first attempts, M'Dowell made his incision on the flank, two inches and a half outside the rectus muscle, and parallel to its direction. Another time, to the incision of the linea alba, he joined another transverse, and slightly oblique upwards, starting from the umbilicus, and terminating at nearly two inches from it, so as to leave a triangular flap. He, however, at last restricted himself to incision of the linea alba, like most other operators who have imitated him.

Proceeding of Monteggia.—This surgeon objects principally to the large incisions of the abdomen. He advises puncturing the tumour with a large trocar, and extracting the liquid; and, after having somewhat enlarged the opening, if necessary, introducing long-branched forceps, like those of Hunter, for the extraction of calculi from the urethra. By means of these forceps he forcibly seizes the sac thus emptied, draws it outside, and then excises it near its base; applying a ligature on its pedicle, the two ends of which are brought out of the wound so as to be withdrawn when the remainder of the sac is completely detached and removed.*

Sacchi very reasonably remarks that, to put this proceeding in execution, the liquid must be thick, enclosed in one sac only; and that the parietes of the cyst must be very thin, and without adhesions. At any rate, the operation is very ingenious, and might well be combined with incision, after the method of Ledran.

SECTION II.—WOUNDS OF THE ABDOMEN.

(1.) *Simple penetrating Wounds.*

All authors speak of simple penetrating wounds; but it is doubtful whether there are any, except those of surgical operations. Even if they did exist, when the wound surpasses the dimensions of a simple puncture, protrusion of the intestine almost always complicates it. The parts protruded should be carefully cleaned, and reduced by the proceedings that will be indicated for the taxis in case of hernia. The external wound is then treated by position sticking-plasters, or even the interrupted or quilled suture. The only special precept is, not to include the peritoneum in the suture.

(2.) *Wounds complicated with Strangulation of the Intestines.*

If the intestines are strangulated by the wound, there are two resources. 1. To diminish the volume of the intestines. Paré says he

* This proceeding is similar to that of Jeaffreson; but he makes an incision one inch and a half long below the umbilicus, without previous puncture; as soon as the cyst is exposed, he punctures it, and, seizing its edges, drags the whole cyst out with a forceps. About half the operations performed have proved fatal.

has found it beneficial to prick them with a needle, to let out gas. 2. To enlarge and free the wound itself. This enlargement should be as slight as possible, to diminish the danger of consecutive ventral hernia; for the same reason it should be made upwards, at the superior angle of the wound, because the intestines press more on the lower than on the upper part of the abdomen. There is no exception to this rule, unless where the incision thus made would correspond to the umbilicus, or would cause you to fear wounding the epigastric artery.

Numerous instruments have been invented for this purpose; but they are almost all forgotten and replaced by the button-pointed bistoury conducted on the director or finger.

First Proceeding.—The wounded person is laid on his back, with his legs and thighs flexed, his head and breast elevated and firmly supported, so as to relax the muscles of the abdomen; the surgeon depresses with his left hand the part of the intestine protruded, whilst with his right he introduces a blunt director into the abdomen. He introduces it perpendicularly at first, until it has penetrated into the abdomen beyond the peritoneum; then he takes it between the thumb and middle of the index-finger of the left hand, the other fingers serving to depress the intestine, and prevent it from rising over the groove of the director. He draws towards himself the intestine protruded, to see that none of it is pinched between the director and edge of the wound, and depresses the handle of the instrument until its groove is in contact with the peritoneum; then he takes in his right hand, between his thumb and index-finger, the bistoury, with its back turned downwards, and its edge upwards, and slides it along the director, at an acute angle, so that its point may rest secure. The bistoury is pushed as far forwards as you judge necessary, and cuts the parts that form the stricture. When you think the dilatation extends far enough, withdraw the sound and bistoury at the same time, without changing their position, to make sure that the point of the cutting instrument has not gone astray, and that it has only cut the parts that it should divide.

Second Proceeding.—When the strangulation is too considerable to allow of the introduction of the director, the surgeon pushes the bundle of intestine toward the inferior angle of the wound with one hand, so as to expose the superior as much as possible, and to be able to place on it the index-finger of the same hand, the nail downwards. This finger also leans on the portion of the intestine next this angle, and puts it out of the way of the bistoury, which the surgeon uses with his other hand, and whose extremity he should place on the integuments close to the nail, and as if he wished to cut on it. The integuments being cut as much as necessary, the muscles and aponeurosis should also be divided, but not so far as the skin. Lastly, when the peritoneum is reached, it also may be incised, but on a director slipped under it, for fear of wounding the intestines. Perhaps you may even do without dividing this membrane, which seems to be of too loose a tissue to cause strangulation, after the skin, muscles, and aponeurosis are sufficiently divided. (Sabatier.)

Third Proceeding.—The left index-finger placed as in the last proceeding, the nail upwards or downwards, a very narrow curved Potts' button-bistoury is passed flat along it, the button being pushed between the skin and intestine, at the superior angle of the wound; then the edge is raised towards the angle, which is incised from within outwards, the back of the instrument being always accompanied by the finger that served for a conductor.

MM. Sanson and Bégin call this bistoury "the best instrument that can be used." We do not see clearly its superiority over the common straight button-bistoury; moreover, the three proceedings may be employed with almost equal advantages; only in every case it is well to envelop the blade of the bistoury in linen, and to have free only the portion necessary.

One of the greatest difficulties is to retain the bundle of intestine, which has a tendency to rise to the level of the instrument, and which, without this precaution, would run the risk of being wounded.

(3.) *Wounds complicated, with protrusion of the Omentum.*

These wounds are met with in three different conditions.—1. Either the omentum is healthy and easily reducible, and you make it re-enter as usual.

2. Or it is strangulated, in which case the indication varies. If the strangulated portion is not extensive, and that, on making your patient bend backwards, he feels no dragging at the region of the stomach, the best thing is to leave it outside, after having washed it, and seen that there is not the slightest fold of intestine with it. The omentum engaged in the wound contracts adhesions with it, and forms a plug that prevents any ulterior danger of hernia. The external portion sphacelates and becomes detached; moreover, no inconvenience results from it. But if the portion protruded is considerable, if it makes the patient bend forward, or if symptoms of strangulation show themselves, the wound must be dilated by one of the three preceding methods. If you use the director you should dilate at the inferior angle of the wound, lest otherwise the extremity of this instrument pierce the omentum, which always comes from above; and that this membrane may not be in addition injured by the knife. (Sabatier.)

3. Lastly, the protruded omentum may be sphacelated. Formerly it was tied at its healthy portion, and the gangrened part removed. This proceeding, subject to serious accidents, has long been given up. Pure and simple incision was substituted; but the spontaneous reduction of the portion preserved, that sometimes follows, may give rise to an internal hemorrhage.

It is agreed, then, that the omentum should be left outside, after having carefully seen that no intestine is with it. Afterwards, if the fetidity is excessive, and the eschar too long in being detached, the greatest part of it may be removed with the bistoury, but without going so far as the living portion, and the rest abandoned to nature. There remains the case in which the omentum and intestines have come out together through a wound too narrow to allow of their reduction: the wound must without hesitation be enlarged by one of the preceding plans, and all returned, beginning with the intestines.

(4.) *Wounds of the Intestinal Tube in general.*

When the wound in the intestine is hidden from view on account of the tightness of the opening in the integuments, it is recommended, as a general rule, to confine yourself to medical means. The same is the rule when the stomach or intestine, presenting at the exterior, is divided only in a small extent. But if the lesion occupies one of the movable intestines, as the jejunum, ilium, or transverse arch of the colon, you are advised to secure it near the external wound, by embracing it in a loop of thread traversing the meso-colon or mesentery, the two ends of which are fastened outside (Boyer). Sir A. Cooper comprises the little wound entirely in a ligature, which perfectly obliterates it, as a ligature on an artery closes the vessel. But the simple looped suture of Palfyn seems to us preferable here.

It is generally agreed that suture is indispensable when the wound is more than one-third of an inch long; but it should never be used unless on the stomach or intestine, protruded through the wound of the abdomen. To seek the wounded viscera in the abdomen would be contrary to all the principles of surgery (Boyer). Nevertheless, Heister professed a different opinion.

The proceedings differ according as the wound is longitudinal or transverse, but of slight extent; or, as there is complete or almost complete section of the intestine, oblique or transverse.

(5.) *Longitudinal Wounds of the Intestine.*

The interrupted suture is used; but we need not again describe it; only you cut the threads near the knot on reducing the intestine. The glovers' suture applied here by Guillaume de Salicet—the loop suture, and the suture “à points passés.”

I. THE GLOVERS' SUTURE. *Ordinary Proceeding.*—Already described for wounds generally. It is here performed with a straight round needle armed with a simple waxed thread. This needle is passed obliquely through the two edges of the wound, brought together, an assistant holding them at one end, and the operator at the other. The first point of suture should be made one line from one of the angles at an equal distance from each edge. The thread is drawn through to within four or five inches of its extremity; then the needle is repassed a second time from the same side as you begin on, and the edges of the wound again traversed with the same obliquity, passing the thread over, as in the stitch called whipping. You continue thus until you reach the other end of the wound; then leaving at the last end about three or four inches of thread, as at the first, you confide the ends to an assistant, who slightly sustains them, allowing for the movement of depression made by the surgeon in reducing the intestine. The reduction accomplished, take them yourself, and draw them slightly outwards, so that the intestine may approach and adhere to the interior surface of the external wound.

You may withdraw the thread five or six days afterwards. For this purpose, cut one end close to the belly, and gently pull the other,

keeping together and supporting with your thumb and index-finger the edges of the wound in the integuments.

Proceeding of Reybard.—He uses an ordinary sewing needle armed with a double thread, the free extremity of which bears, instead of a knot, a little roll of linen a quarter of an inch long. The thread is greased with oil or cerate, a precaution that renders the operation very easy.

You begin by piercing from within outwards, and near the angle of the intestinal wound, the lip of this wound that is next you, so as to leave the little roll within the intestine. Then you bring the edges of the wound together, and pierce both sides at once, as in the last proceeding, and continue on to the other angle of the wound; with this difference only, that you place the points nearer together, and tighten a little more. This suture terminates also in a special manner. For instance, to fasten the thread, you pass back the needle under the last stitch but one, and you finish the last point of suture with a single thread; then tie the single thread with the other, and cut off the ends close to the wound.

You then reduce the intestine, letting go the threads, which afterwards, when reunion is complete, divide the soft parts they embrace, and, falling into the intestines, are discharged in the stools.

The roll of linen may be dispensed with; in which case, in order to fix the thread, after having traversed the two edges of the wound very near its angle, the needle is passed between the two ends of thread that compose the needleful. But M. Reybard prefers the roll of linen, which has the advantage of drawing away the thread sooner.

II. THE LOOP SUTURE. *Proceeding of Palfyn.*—Setting out with the principle, that it is of less consequence to unite the lips of the wound together than to put them in contact with some other point to which they might adhere, Palfyn was content with passing a loop of thread in the middle of the wound of the intestine, approximating it to the external wound, and fixing the threads to the integuments by means of adhesive plaster.

Proceeding of Ledran.—He took as many threads as he wished to make points of suture, and threaded each in an ordinary sewing needle. The edges of the wound being then put together, he passed these needles directly through without any obliquity, and at least a quarter of an inch apart. When all were put through, he removed the needles, and tied together all the threads of each side separately. The two bundles of threads that resulted from each side were then collected together, and twisted into one. By this means the divided portion of intestine puckers, and the points of suture approximate; and Ledran thought that these puckers would prevent the edges of the wound from becoming separated, and would cause their mutual reunion without adherence to any other part.

Proceeding of M. Reybard.—He used a plate of deal, thin and polished, about one inch and a half long by three-quarters wide, and oval, so that there might not be any corners to prick the intestine. He suspended it in a loop of thread, the two ends of which, that traversed it in the middle, were separated about two lines apart. At

each end of the thread was placed an ordinary needle. The little plate, thus prepared, was carried into the cavity of the intestine in such a way that its largest diameter corresponded to that of the wound. It was maintained in this position by piercing from within outwards, a quarter of an inch from their free edges, each of the lips of the intestine with the needle on each end of the thread; the two ends were then withdrawn, and united together to be threaded in a curved needle. This curved needle was carried into the belly, and directed in such a way as to be brought from within outwards through the abdominal parietes a quarter of an inch from the external wound. The double thread brought out in this way was now confided to an assistant, whilst the surgeon reduced the intestine. This accomplished, the surgeon took the thread, and, drawing it tightly, assured himself that the intestine was well applied against the abdominal parietes; and, lastly, finished the operation by tying the threads over a roll of linen placed parallelly to the internal lip of the wound.

Two days afterwards, these threads were cut; and the next day the plate of wood was brought away in the stools.

It may be seen that the wound of the intestine was united by means of the plate of wood, that completely stopped it up, and at the same time applied its lips against the abdominal parietes, and retained them without too much compressing them, until they had contracted adhesions with the peritoneum.

This is a kind of reminiscence of the elder tube, or bit of trachea, used by the surgeons of the Middle Ages; but the kind of suture used is infinitely more simple.

Proceeding of Jobert.—The edges of the wound having been washed with warm water, turn them inwards with the needle, and pass the threads transversely through the borders, taking care that they are close enough to prevent the parts in the intervals from becoming protruded, and to keep the serous membranes in constant contact. That done, you may collect the threads into one bundle, and bring them outside, as in the proceeding of Ledran; or make as many points of interrupted suture as there are threads. You may, in the latter case, cut these ends off, when they fall into the intestine; or bring them outside, when they will come away on the fourth or fifth day.

III. SUTURE "*à points passés.*" *Proceeding of Bertrand.*—A common straight needle and a waxed thread are all that are necessary. The lips of the wound are held as usual; then the surgeon pierces them both rather obliquely, about two lines from their free edge and one from their extremity; then he repasses the needle in the same way on the opposite side, two lines farther on and in the same direction, and continues on to the other end, just as a tailor bastes in his linings. The intestine is then reduced, and the two ends of thread are fixed outside; some days afterwards you may withdraw them; for this purpose cut one end near the wound, and pull the other. Some surgeons bring out the two ends of thread through the edges of the wound of the integuments, to better fix the instrument, a proceeding since imitated by M. Reybard. Others fear, lest the traction made on the thread, notwithstanding the suppuration that has dilated the punctures, should

tend to destroy the still feeble adhesions of the intestine. To prevent this inconvenience, the following proceeding, attributed to B  clard, was invented.

Proceeding of B  clard.—Arm the needle with two threads, one white and the other coloured; when you wish to withdraw them, pull the white thread at one end, and the coloured at the other; the effect of these two simultaneous tractions, in opposite directions, is to leave the intestine immovable.

Appreciation.—In order that you may form a good judgment of these proceedings, we must give an exact account of the effects of ligature.

If a portion of intestine is strangulated, whether by suture or ligature, the mucous and muscular membranes are at once divided; the serous alone remains uninjured. If the serous is already inflamed, its resistance is slight in proportion as the inflammation is strong. Lastly, even when healthy it is liable to be divided when tied in a simple thread, but resists waxed thread better. (Jobert.)

After the suture is put in, the following occurrences take place. In the first fifteen hours there is an effusion of plastic lymph, not only on and between the edges of the wound, but also beyond the points of suture, which are enveloped on all sides by it; then a solid organization of the false membrane that unites the lips of the wound and the intestine to the parietes of the abdomen and surrounding serous surfaces. After the first three or four days, the thread excites a kind of suppuration in the false membranes, and cuts all that was embraced in the knot. In this way they become free, and fall into the intestine if left in the wound; or may be pulled away as the ligature from an artery.

At the end of five or six days the reunion is firm; but it exists by means of adhesion of the intestine to all the parts near the wound. After one or two months these adhesions have disappeared, and the intestine has again become free in the abdomen. The wound is united by a new cicatricial tissue, easily distinguished on the serous and muscular tissues. But I have demonstrated, notwithstanding, the assertion of M. Reybard to the contrary, that the edges of the wound in the mucous membrane reunite, without leaving any intermediate cicatricial tissue. But these results have only been obtained on dogs; and the cases observed in man seem to put off, to a much more remote epoch, the destruction of the peritoneal adhesions, at least in large wounds of the intestine.

It results from these facts, that in all sutures with tightened points it is important: 1, to use waxed threads; 2, to tighten the less the more inflammation there is in the serous membrane; and 3, when you have to tighten much, instead of comprising the three tunics in the suture, you may content yourself with embracing the serous tunic only.

As to the choice of suture—when you use a perfectly united suture, the threads themselves fall into the intestine, without injuring the external adherences; consequently it seems better to cut off the threads at the wound than to bring the ends outside. The only question then is

between the whipped suture of Reybard, or the interrupted of Jobert. But here another material circumstance must be considered; when a great number of points of suture have been put in, you run a great risk of bringing on a peritonitis, or phlegmonous enteritis (Jobert); and, besides the pricks made in the intestine, we must doubtless lay the blame on the constriction and pinching of its membranes. Moreover, immediate reunion is but a small advantage; and it seems very doubtful whether it can be obtained.

En resumé.—The best method is, then, that which least multiplies the points of suture, produces least constriction, and of which the threads can be most easily withdrawn. The loop suture has the advantage in these respects over all the others. We prefer, then, for small wounds the suture of Palfyn; for others the suture of Reybard; and perhaps for very extensive divisions the proceeding of Jobert.

(6.) *Section of the Intestines across.*

The intestines may be completely or almost entirely divided, obliquely or across, by a cutting instrument; but it is most often, in consequence of strangulated hernia (gangrene of the intestine obliging us to remove a portion), that a complete transverse section is made. Until towards the end of the seventeenth century, these lesions were deemed incurable, and abandoned to nature. Verduc was the first to recommend transforming them into an artificial anus, by sewing the ends of the intestine to the lips of the wound in the integuments. Litre was content with attaching the upper end to the external wound by three needles, applying on the lower end a ligature. Lapeyronie passed another thread into the mesentery, close to the ends of the intestine, to retain them both at the external wound. Scarpa, in the case of hernia only, would have us leave it to nature, and trust to the adhesions already formed.

But reunion of the intestine, tried for the first time by Ramdohr, gained more favour; it may be performed in four ways.

I. **METHOD OF RAMDOHR. INVAGINATION.**—Ramdohr introduced the upper end into the lower, and maintained them by a point of suture moderately tightened. Hermans applied the glover's suture to the two ends thus invaginated. Vermeil enveloped the ends of the intestine in a fold of mesentery, which he comprised in the suture. Ritch advised, for facilitating the introduction of the upper end, to place in it a card rolled up and varnished; the invagination finished, he passed a loop of thread through the two ends of the intestine, and the cylinder of card, at the same time; tied the threads two or three inches from the intestine, and secured them in the external wound. Chopart and Desault, fearing that this thread, which traversed the intestine, would hinder the passage of the *fæces*, basted the semicircumference of the cylinder of card with the thread, so that it traversed the two ends of intestine and the cylinder, but did not pass across the inside of the latter.

This method offers several difficulties. The first is to distinguish the upper end of the intestine from the lower.

The only means, proposed by Louis, is to retain both ends outside,

and administer a purgative; of course, if the wound was in the large intestine, it would be better to administer a clyster. The second difficulty is, the introduction of the upper end into the lower. On one hand the portion of mesentery belonging to the end forms an obstacle to a tolerably deep invagination; Louis removed this difficulty by incising the mesentery to a sufficient extent along the upper end. And on the other hand, the lower end, contracted, and puckered, with its mucous membrane reversed outwards, presents such an obstacle that Dr. Smith could not overcome it, though he introduced a candle into the upper end to act as a stylet. The modification of Chopart and Desault slightly diminishes the difficulty; in fact, the thread passed first across the cylinder and upper end, being then conducted across the inferior from within outwards, helps to draw one in the other.

Jobert has invented a more simple and efficacious plan. He traversed the anterior part of the upper end with a silk, armed with two needles; these two needles he then passed into the inferior end, traversing from within outwards the corresponding wall, and, by gentle tractions, introduced one end inside the other, without the intermediation of the cylinder.

In the third place, it is objected that a mucous membrane cannot reunite with a serous. M. Jobert consequently proposes, after having introduced the two ends, one inside the other, for about two lines at farthest, to pass a very fine waxed thread alternately through the serous membrane of the superior end, and that of the inferior; a modification that we shall see again presently in the proceeding of the same author. So much precaution seems unnecessary. Reunion taking place first by false membranes, and by means of adhesions with all the surrounding parts, it is of little consequence what tissues are in contact.

The failures of the proceeding of Ramdohr are due principally to the small number of points of suture used, which allow the intestinal matter to be effused before the first adhesions have been formed. With several points of interrupted suture, or with the glover's suture employed by Hermans, no fear need be entertained on this account.

II. METHOD OF DUVERGER. DIRECT REUNION.—Duverger used a portion of a calf's trachea prepared, furnished with three loops of thread placed at equal distances, each end being armed with a small curved needle. It was first put in hot wine, to make it more supple and warm; and afterwards steeped in a mixture of balsam of Peru and Commandeur; he then introduced it into the intestine in such a way that it supported the two ends; and, by means of the curved needles, he made three points of interrupted suture, passing them from within outwards, three or four lines from the edges of the wound, which an assistant held together. The knots were made at one side of the wound.

Proceeding of Sabatier.—He replaced the calf's trachea by a bit of card rolled up, and proposed to substitute, for the three points of suture, a single one traversing the cylinder and two ends of intestine together. This proceeding certainly exposes to effusions of fæcal matter, and seems perfectly impracticable.

Proceeding of Jobert.—When the omentum presents itself in front

of the wounded intestine, he seizes a fold of it, which he interposes between the edges of the wound, without detaching it from the rest of the layer; he then brings together the lips of the wound, and unites by the suture of Ledran, which does not cause any strangulation, and, consequently, none of the accidents that follow it. Union takes place very well; and at the autopsy you find in the intestine a floating layer of omentum, which in nowise diminishes its calibre.

III. METHOD OF JOBERT. REUNION OF THE SEROUS MEMBRANES.—M. Jobert conceived the idea of putting the serous membranes in contact, by means of a new kind of invagination. The upper end being well recognized, lay your patient on his back, with the muscles of his abdomen as relaxed as possible, and dissect off the mesentery of each end to the extent of nearly one-third of an inch. Some blood always flows, which you need not stop, as it is an obstacle to the inflammatory actions. But if the hemorrhage is too abundant, apply temporary ligatures, which you remove after the operation.

This first step finished, the surgeon seizes the upper end with his left hand; with his right he takes a thread five or six inches long, furnished with two ordinary needles, and traverses, with one needle, the anterior wall of the intestine from within outwards, two inches from the wound, in such a way as to leave in the puncture a loop, the two ends of which are confided to an assistant; a second thread is passed in the same manner across the posterior wall. Then, abandoning the upper end, the surgeon proceeds with his fingers, or, still better, with a dissecting forceps, to double the lower end inside itself, so that the serous membrane is on the inside. He chooses for this manœuvre a moment when the intestine is at rest (you may make it still more easy by passing along the edges of the wound a pencil, dipped in a weak solution of opium).

The doubling being effected, the left index finger is introduced to sustain it, and serve as a conductor for the needles. The two needles of the anterior loop are taken, and passed in turn along the radial border of this finger from within outwards, through the doubled part of the inferior end, being brought out at a distance of one line from each other. The needles of the posterior loop are conducted in the same way on the ulnar edge of the index-finger, and traverse the intestine on the opposite side. Then the two ends of intestine are gently brought together; and, when they are almost mouth to mouth, the finger is withdrawn; and, on gently pulling the ends of thread, by degrees the upper end is introduced into the lower, a round polished body being used to assist it. The intestine is then reduced into the abdomen, and the threads, twisted together, are brought out at the lower angle of the external wound, and fastened to the abdomen by a bit of sticking plaster; on the fourth or fifth day the cicatrix is formed, and the threads may be withdrawn.

Proceeding of Lembert.—As many threads, each armed with a needle, must be prepared as there are points of suture required; the needle is pushed in, a quarter or half an inch from the edge, penetrating as far as the mucous membrane; then repassed from within outwards, so as to come out about one line from the edge. You then, in the

same way, pass it into the other end, beginning one line from the wound, and bringing it out about a quarter of an inch off. All the threads being passed in the same way, you have only to draw them together to approximate the ends of the intestine, and put their serous surfaces in contact, forcing the lips of the wound to double inwards; each point of suture is secured by a double knot; cut off the threads on a level with the wound, and reduce the intestine. This proceeding was tried on the human subject by M. J. Cloquet; two points of suture sufficed to obtain the re-union.

Proceeding of M. Denans.—In addition to needles, three silver or copper rings or ferrules (*virole*), are required. The two first three lines and a half long, and equal in circumference to the divided intestine, are introduced, one into the upper, the other into the lower end. After which a portion of each end, two lines in depth, is doubled into its respective ring; and the third ring, half an inch long, and just small enough to be received inside the two others, is fixed, first in one and then in the other, in such a way that the three rings enclose between them the extremities of the inverted intestine.

To retain the apparatus in place, two needles must be threaded on the same thread; one is passed into the intestine above the upper ring, pushed through the canal of the three rings, and brought out below the inferior ring, so that the apparatus is embraced by the loop of thread. The needle is then returned through the hole it came out at, and passed between the external surface of the ring and the internal surface of the intestine, and brought out through the intestine at the spot where it is doubled in. Then he pulls the thread, the loop of which re-enters by the puncture, like a stitch that is unsewn. The other needle is passed back in the same manner; and the result is that the loop of thread embraces only the three rings, without including the intestine, except at the point where the needles came out. A double knot is then made, and the threads cut off as short as possible; a similar ligature is placed on the other side, and then the intestine is reduced as usual. The following is the result: the serous membranes in contact first unite, the portions doubled in mortify, and the rings, becoming free, are carried off in the stools.

IV. METHOD OF AMUSSAT.—This surgeon has tried on animals another method, which consists in placing in the intestine a cork expanded at its ends, narrowed in the centre, so as to present a central groove or furrow. The two ends of intestine having been invaginated within each other, in such a way that both cover this gutter, they are tied on it tightly with a strong thread, and all the portion of the intestine that passes this ligature is cut off with a scissors. The following takes place:—the serous membrane of the two ends covers the ligature and adheres together, in consequence of the inflammation determined by it. After a certain time the ligature cuts the parts it embraces, and falls into the intestine, coming away in the stools; and in dogs the intestine is not found narrowed by this proceeding. There is this advantage here, that you have no need to see which is the upper or lower end of the intestine to invaginate. But there is something astonishing in this proceeding; and, before trying it on the human body, it requires further meditation and experiment.

Appreciation.—The first methods have all succeeded in turn; and, when their most perfect proceedings are chosen, they offer equal chances. It may be objected to the method of Ramdohr that it leaves in the intestine a kind of valve, which has a tendency to contract; that of Jobert is not exempt from the same reproach. That of Duverger gives more reason to fear, lest a point of suture giving way, effusion should take place into the peritoneum. Moreover, the primitive reunion always taking place by adhesions to the neighbouring tissues, it seems to us of very little use to fit exactly together the serous membrane.

Everything being taken into account, there are only two points of view to regard the question in, viz., the facility of execution and the number of points of suture, a powerful cause of irritation. In respect to the first, the method of Ramdohr is certainly inferior to the others. In respect to the second, the method of Duverger requires too numerous and approximated points of suture. The third method remains, in which the proceeding of Lembert is evidently the best, on account of its simplicity. It is to it, then, that we give the preference.

SECTION III.—HERNIA.

The cases of hernia that require the assistance of operative surgery are — inguinal hernia, crural hernia, and umbilical or exomphalic hernia. We class with them the account of artificial anus, which arises most generally from strangulated hernia.

(1.) *Inguinal Hernia.*

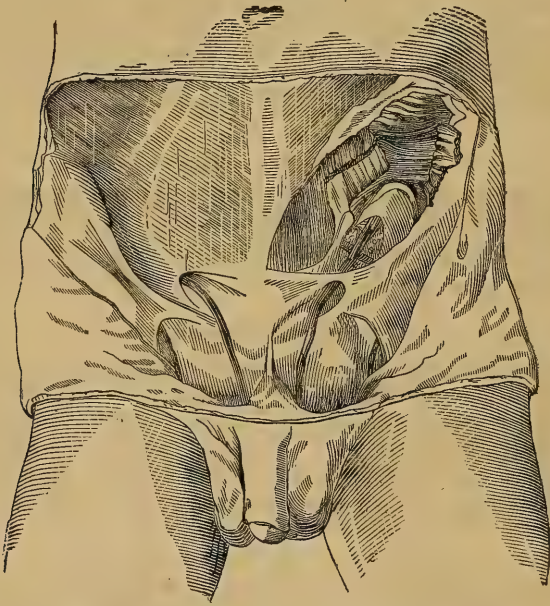
The anatomical data necessary for the surgical treatment of this hernia differ in the adult and infant. In the adult male, the inguinal canal is a sort of passage, about one inch and a half in length, through which passes the spermatic cord. In the female it is a little longer, and much more narrow; and it is occupied by the round ligament of the uterus, which partly accounts for the rarity of inguinal hernia in woman.

The inguinal canal has two orifices; one internal or abdominal, corresponding very nearly to the middle of the space that separates the spine of the ilium from the pubis, formed by a kind of prolongation of the *fascia transversalis*, inverted on itself as the finger of a glove, and forming also a sheath for the spermatic cord. The other external, called also the inguinal ring, almost triangular, formed by the divergence of the two strong bands of the aponeurosis of the obliquus externus, which are called the pillars of the ring, one of which is inserted into the spine, and the other into the symphysis pubis. The internal side of this ring is about one inch from the symphysis pubis; its greatest diameter is parallel to the crural arch, and consequently directed upwards and outwards.

The course of the canal, cylindrical like the cord it embraces, follows the same direction as the crural arch, from which it is separated by an interval of not more than from one-third to half an inch. Its circumference is divided into four walls; an anterior, formed by the

aponeurosis of the external oblique; a posterior, by the *fascia transversalis*, very strong here; an inferior, which here presents a kind of gutter, resulting from the union of the aponeurosis of the external oblique in front, with the fascia transversalis behind, and the external projection of which is Poupart's ligament. The superior wall, strictly speaking, does not exist; it is represented by the lower edge of the internal oblique, but this disposition is not constant. Sometimes the spermatic cord traverses the fibres of the internal oblique, which thus form for it a complete envelop, more rarely the transversalis also; and this muscular ring, single or double, has been brought forward to account for a supposed spasmodic strangulation, pointed out by several authors.

Fig. 19.



Anatomy of the inguinal canal, from a cast in the Museum of King's College, London.

Inguinal hernia, developed in the adult, is composed of a peritoneal sac, and in general a portion of omentum or small intestine; but almost every movable viscera of the abdomen has been found in them. The sac may become thickened, burst, be filled with serum, or contract adhesions; its neck becomes narrowed, and in time is solid enough to be the essential seat of strangulation. A sac has sometimes been found with several necks, when the first is driven out by an effort that produces a fresh hernia. The intestines may also present adhesions; but we cannot be aware of all these anomalies beforehand, nor consequently establish any general precepts for the operation.

When a real strangulation takes place it has always been found at the neck of the sac, when the hernia has followed its usual course.

The external inguinal ring, and the anterior wall, are covered by the fascia superficialis, and by the skin. The internal ring and the posterior surface are lined by the peritoneum, whose relations we must mention.

Opposite the internal ring the peritoneum presents, first, a little depression, the last vestige of the tunica vaginalis; it is named the *external inguinal fossa*: here the common or oblique inguinal hernia protrudes. A little more internally exists a second depression of the peritoneum, the *internal inguinal fossa*, corresponding to the posterior wall of the canal; here the hernia, called direct, protrudes. This depression is bounded on the inside by the projection of the umbilical artery, transformed into a fibrous cord; more internally still is found another depression, extending from the umbilical artery to the external border of the tendon of the rectus muscle, and which has been named by Velpeau *vesico-inguinal* or *vesico-pubic*. It corresponds to the external inguinal opening, or is even more to the inside; the hernias that come out here are called *direct* or *internal inguinal*. Any hernia that protrudes through a split in the aponeurosis may be strangled by the neck of the sac, or by the abnormal opening that gives passage to it.

The external inguinal ring is not bordered by any vessel; so that you may incise it on any side without fear. But the same is not the case with the internal ring. In the first place, opposite it in the subcutaneous layer, we meet the tegumentary artery, which passes up obliquely to the umbilicus, from the middle of the space between the pubis and spine of the ilium.

But the epigastric artery is of more importance. Springing from the external iliac, almost immediately beneath the internal ring, it passes up between the fascia transversalis and the peritoneum, bordering round the internal semi-circumference of this ring, and, consequently, placed between the external inguinal fossa and the internal (see my *Anatomie Chirurgicale*).

You see, by this, what are the relations of an internal or external hernia with the epigastric artery, and in what direction the efforts at reduction should be made. But with time the canal changes its size and direction.

In old and voluminous hernias it becomes much enlarged; the internal ring becomes approximated to the external, and they are sometimes confounded into one opening, the canal having entirely disappeared. Sometimes also it happens in these cases that the spermatic cord is flattened by the hernia, and all its parts separated and scattered; then, in the operation of dilatation, you run a chance of finding under your knife the spermatic artery, displaced.

In the infant the inguinal canal is as it were but one opening; the two rings correspond almost exactly. But, moreover, it is occupied by the tunica vaginalis, which still communicates with the peritoneum.

According to Camper, this communication exists at birth on each side, in almost half of the subjects; on the right side in almost a quarter; on the left in about one-eighth; which explains the greater frequency of congenital hernia on the right side.

In time this communication is obliterated, and by the enlargement

of the pelvis, the internal ring being drawn outwards whilst the external remains almost in the same place, the canal is formed as we have described.

It follows from this that congenital hernia has no peritoneal sac ; but that it is in contact with the tunica vaginalis and testicle : that it is always external ; that is to say, that it always has the epigastric artery internal to its neck, and that the efforts of reduction should be directed almost entirely from before backwards, and from below upwards.

All the operations for inguinal hernia may be ranged under these four principal heads: 1. Palliative treatment, 2. Radical cure, 3. Proceedings of reduction, 4. Operation of dilatation, or cutting the stricture, "herniotomy."

Palliative Treatment.

This consists in the application of bandages, which are made of various materials, and of different shapes ; the principal are the English ; the old or French, the spring of which forms part of the girdle, and this is distinguished especially by the shape of the spring ; and the bandage, called "*franc comptois*," the girdle of which is soft, and the spring is in the pad itself. To the spring of the English and French trusses are attached hard or soft pads of ivory, wood, hair, or caoutchouc, stuffed or containing air, fixed or movable ; and these springs and pads also have undergone a host of modifications, most of them relying on patents, or favourable reports from scientific societies.

A deep research into this subject has shown us—

1. That three-quarters of the hernias are badly supported by any truss applied in the ordinary manner.

2. That, as a general rule, the English spring is far preferable to the old one.

3. That movable pads, in a great number of cases, have some real advantages over the fixed.

4. That, in oblique inguinal hernia, the pad should press on the course of the canal, and on the internal orifice, without touching the pubis, unless in some exceptional cases.

5. That, in direct hernia, the pad should be more voluminous, fixed, and resting on the pubis.

6. That hard pads are most suitable for compressing the canal, soft ones for direct hernia.

7. That it is much to be wished that surgeons would pay special attention to this very important branch of our art, which has been too long left to bandagists.

Radical Cure.

Several means have been advised and employed. Such as—

1. *Castration*, long since proscribed and rejected.

2. *Cauterization* with the hot iron, or caustics, sometimes applied on the integuments themselves, the hernia having been reduced, and the cord put on one side ; or, according to the advice of Monro, the skin being first divided, so as to act directly on the hernial sac.

3. *Ligature of the sac*, which consisted formerly in, after having incised the integuments, passing round the sac, including the cord, a needle furnished with a gold or lead wire, the ends of which were twisted to strangle the parts. This was called the "*point doré*." The superfluous ends were then cut off, and the wound was closed over it. The division of the cord that followed necessarily caused atrophy of the testicle.

Since the time of A. Paré, ligature has been performed in a more rational manner, the hernial sac only being comprised in it, the cord being carefully put out of the way; and more lately it is done with ordinary threads of silk or catgut.

4. *The royal suture*. For this the sac was exposed entirely; it was then raised and sewn up by a suture, like that for wounds of the intestine, after which the portion of the sac outside the suture was excised, and the wound lightly dressed, until the threads came away.

5. *The Proceeding of Espagnol*, which consists in incising the sac, pushing back the testicle into the abdomen, and then making the *point doré*, and cicatrizing the wound.

6. *Scarifications*, performed on the anterior wall of the sac only, (for fear of wounding the spermatic vessels) seconded by direct compression.

7. *Reduction of the hernial sac*, dissected from its adhesions.

8. *Mediate compression*, by means of a truss applied on the canal. This method has obtained incontestable success, especially on young subjects; for adults, rest in the horizontal position is also enjoined, a practice recently renewed with advantage by M. Ravin.

9. *Obliteration of the ring*, by means of a plug, of integuments, after the autoplasmic method of Jameson.

10. Lastly, the proceedings of MM. Belmas, Gerdy, Bonnet, and Guérin; which, for their originality and novelty, deserve special description.

Proceedings of M. Belmas.—The instruments necessary for the operation are, 1. An ordinary lancet. 2. Two small blunt hooks, each mounted in a handle. 3. A metallic canula, six inches and a half in length, by one line and a half in diameter, representing the arch of a circle of six inches and a half radius, and furnished near its external extremity with a plate by which it may be held. 4. A stylet with a similar curve, terminated at one end by a trocar's point, and screwed at the other to a grooved metallic collar, round which is fixed by a strong ligature a membranous pouch, made of a portion of dissected intestine ("*baudruche*") empty, and thin enough to traverse the canula. 5. An ordinary ligature forceps. 6. An inflating canula, formed of two tubes divided, one furnished with a cock, and which fits to the collar of the membranous pouch; the other having at its extremity another membranous pouch, inflated with air, and which can only be emptied by opening the cock.

Everything being thus prepared, the patient is laid on his back, with the muscles of his abdomen relaxed, and his pelvis a little raised, and inclined to the side opposite the hernia; the hernia is first reduced, and then an assistant keeps it back, with his finger pressing on the ring.

The surgeon then raises the parietes of the hernial sac, slides them between his fingers to make sure that they are empty, and at the most depending part of the pouch makes a puncture with the lancet.

Through this small opening, the lips of which are held apart with the blunt hooks, he introduces the metallic canula into the sac, and passes it cautiously along the internal wall of the hernial pouch to its neck, and with its internal extremity raises the skin on a level with the ring. He then grasps the projection thus formed with his left index-finger and thumb, and thus fixes the canula, assuring himself that no part is included between it and the sac.

The assistant then passes the stylet through the canula, with its point forwards, and pushes it from within outwards, through the sac and integuments. As soon as it sufficiently projects, the operator seizes it with the fingers that supported the conducting canula, and, whilst he withdraws the latter with his right hand, he draws the stylet through with his left, until the metallic collar appears above the level of the skin. He seizes this collar with the forceps, unscrews the stylet, and replaces it by the inflating sound; when the latter is well adjusted, he opens its cock, and, by slight pressure made on the external pouch, causes the air it contains to pass into the internal pouch; then he closes the cock, and removes the external portion of the tube, which is of no further use.

By all these means, then, he has placed in the sac, on a level with the ring, a pouch of intestine full of air, on which a methodical compression is made, in order that the sac may apply exactly over it, and that the hernia may remain reduced. Twenty-four hours after the operation he opens the cock at intervals, and favours the escape of the air shut up in the pouch, by gentle pressure. When it is supposed to be empty, which takes place generally in from forty to forty-eight hours, by gentle traction on the cock, draw out the metallic collar, and establish a graduated methodical compression, which should be kept up for at least fifteen days, to insure the success of the operation. The following occurrences take place:—The membranous pouch produces, by its presence, an abundant exhalation of serum; it becomes impregnated with it, and becomes filled with it as by imbibition; afterwards this serum is condensed, and becomes at last organized into an actual fibrous plug, which hermetically closes the hernial opening, and contracts solid adhesions with the neighbouring parts. The membranous pouch itself seems to be absorbed after a time.

Proceeding of M. Gerdy.—The instruments necessary are—1. A curved needle, pierced with an eye at its extremity, mounted on a fixed and solid handle. 2. Six tubes of quill, or bougie for the quilled suture. 3. A bottle of concentrated liquor ammoniæ, and a pencil to apply it with. 4. Six double ligatures.

The patient lying down, the surgeon places his left index-finger under the anterior origin of the scrotum, pushes back the skin from below upwards into the ring, and even into the inguinal canal as far as possible, leaving behind the spermatic cord. The needle, armed with a double thread, is then directed on the index-finger to the bottom of this kind of cul-de-sac, and, by a movement of depression, its

point is brought out in front, so as to traverse at the same time the skin pushed back, the anterior wall of the canal, and the skin of the abdominal parietes; as soon as the eye is seen outside, one end of the ligature is disengaged and kept outside, whilst the needle is withdrawn with the other end. It is then replunged through the same tissues, to be brought out half an inch from its first point of issue, and the second end of thread disengaged in the same way.

The cul-de-sac formed by the skin of the scrotum pushed back is now retained by a loop of thread in the canal where the finger pushed it. The threads of one side are then tied on a quill half an inch long and the threads of the other on another tube; he thus obtains a first point of quilled suture. Two other points of suture are made in the same way, one on the inside, the other on the out, at half an inch distance at least from the first. This done, the surgeon dips the pencil in the concentrated liq. ammoniæ, and passes the caustic to the bottom of the cul-de-sac formed by the skin of the scrotum, and reiterates this cauterization until the epidermis is destroyed in the whole extent of the cul-de-sac. The operation is then terminated. The inflammation affects this denuded skin; its two surfaces in contact suppurate, and adhere by about the eighth day: the threads are removed, and the canal is obliterated.

Proceeding of M. Bonnet.—The necessary instruments are—1. Three or four ordinary pins, one inch and a half long. 2. As many bits of cork, of the size and shape of the end of your little finger, and hemispherical. 3. A forceps. Before using the pins, each of them is passed through the middle of one of the bits of cork, the convexity of which is turned towards the point; and the cork is passed up to the head of the pin, whose size it augments.

The hernia being reduced, he seizes the root of the scrotum as near as possible to the ring, and places the cord in the circle formed by his left finger and thumb squeezed together; passes a pin in front of their nails, behind the envelopes of the hernia, and near the suspensory ligament of the penis, and pushes it on until its head of cork rests on the skin, and its point projects outside. Then a second bit of cork is put on, with its flat surface towards the point, and pushed sufficiently to slightly compress the parts between the two corks; to maintain which compression, the end of the pin is bent up spirally by means of the forceps.

The first pin being thus placed, the cord is brought between it and the fingers, which are again compressed together, and a second pin is put in, parallel to, but half or three-quarters of an inch outside the first. The cord is thus between the two pins; but if, by the pressure of the hernia, the vessels and nerves that compose it have been separated and dispersed, and cannot all be brought together again into this interval, you should place the remains of it between the second and third pin, pushed in also half or three-quarters of an inch outside the preceding.

Pain and inflammation come on generally about the fourth day. The pins are withdrawn when the inflammation is strong enough, and their posterior heads commence to ulcerate the skin. To extract them, you

must cut off their ends. Three weeks or a month suffices to obliterate the inguinal ring.*

Proceeding of M. J. Guerin.—The patient lying on a bed with his thighs separated and semiflexed, and the pelvis and superior parts depressed, the hernia also being reduced, the operator raises a transverse fold of the skin of the internal and inferior part of the groin, pubis, and root of the scrotum, and draws it from below upwards to the level of the orifice of the canal. At the base of this fold he plunges in a small lance-shaped bistoury as far as the entrance to the canal, above, and to the inside of the spermatic cord, which an assistant carefully holds downwards and outside. In this opening he passes a convex myotome, with a rounded and blunted point, about one inch long, by one or two lines broad, with a blunt heel two inches long. The entire blade being buried in the canal, he cuts first obliquely from behind forwards and within outwards, to a depth of about one-third of an inch, first assuring himself, by feeling, of the situation of the cord. He then turns the blade, and incises successively upwards and downwards in the internal angle, near the pubis, all the parts on the stretch formed by the two divisions of Poupart's ligament, and the fibres of the external oblique, which terminate these. Lastly, he makes several superficial scarifications in the parts lying between the three principal incisions.

These different sections, though being each one-third of an inch long, and occupying a part of the canal, should only reach the aponeurosis of the external oblique, and are in consequence limited to the superficial surface of the canal and its external orifice.

The only time this operation was tried, it occupied ten minutes, and caused the loss of a few ounces of blood. After the expulsion of the air and blood contained in the wound, the external puncture was closed; a compress laid on the course of the canal, with a spica bandage, and eight days afterwards a truss was put on. On the twenty-first day the patient got up; at the end of six weeks he left off his truss; and six weeks afterwards the hernia had shown no tendency to return.

Appreciation.—These proceedings may be divided into three classes. Some, such as the "point doré" and castration, destroying the testicle, should be at once rejected; others have not this serious fault; but, as they require the sac to be uncovered, they expose the patient to peritonitis, which experience has shown to be much more frequent after these operations than after those for strangulated hernia (J. L. Petit); and they do not insure a more certain radical cure than the others. The four last described proceedings deserve a more serious attention. That of Belmas seems sure enough, for it obliterates the canal completely; but it is more complicated, and predisposes more to peritonitis than the others. That of Gerdy is very simple, but it does not plug

* M. Jobert de Lamballe frequently follows a somewhat similar method, it is said, with great success. The intestine being reduced, one, two, or three pins are passed through the hernial sac and spermatic cord, the spot at which they enter being at some distance from that at which they come out. The twisted suture is next applied, moderately tightened, and left in situ eight or nine days, until the cuticle is slightly excoriated. He makes the patient wear a truss for some time afterwards.

up a quarter of the canal, and only transforms an external inguinal hernia into an interstitial. That of Bonnet, still more simple, does not obliterate any portion of the canal; and the hernia will probably reappear externally, sooner or later. That of Guerin seems, at first sight, to combine the simplicity of the one set with the efficacy of the other; but it is doubtful whether it goes much farther into the canal than that of Gerdy, to which, nevertheless, I prefer it. On the whole, I should always regard it as very rash to attempt so hazardous an operation, when we may obtain the same end by compression—a plan that is always innocent, and very often efficacious with children; and which, in my opinion, might be so also with adults, if suitably applied. I have seen an inguinal hernia cured in one month in an old man sixty-eight years of age, by complete obliteration of the inguinal canal, obtained by means of simple compression. The recumbent position may favour its action. Astringent tonics have been advised at the same time: all you can say of them is, that they may act on the imagination of the patient, and encourage him, but cannot do any harm.

Proceedings of Reduction.

A great number of accessory means have been proposed, such as bleeding, leeches, baths, lavements, purgatives, opiates, and especially belladonna rubbed into the tumour, or passed on a sound into the urethra, cold lotions, and astringents, &c. Electro-puncture has been tried on dogs by Leroy d'Etiolles, by means of a needle planted into the tumour, and forming one extremity of a galvanic circle, the other end of which is in contact with the tongue or anus, according as the large or small intestine is protruded.

The purely surgical means are four in number—position, compression, the taxis, and operation; this last is confined to cases of strangulation only, where all the others have failed.

I. POSITION.—Generally we place the patient so as to relax at the same time the muscles of the abdomen and the opening through which the hernia protrudes. He should then be placed on his back, with his shoulders and head supported by pillows, his pelvis elevated, and his legs and thighs flexed. But this position must be aided by the taxis. The same is the case with the position recommended by Paré, which consists in placing the patient with his head downwards and his buttocks elevated.

The following positions, alone, have sometimes succeeded, when even the taxis has failed.

1. The patient is suspended by his hands and feet, with his body reversed, and his head bent downwards, and repeatedly shaken. (Fabrice d'Aquapendente.)

2. The patient is suspended with his head downwards, and his knees bent over the shoulders of a strong man and kept in this position for some time, being occasionally shaken. This position has been modified by resting the patient's head and chest on a bed instead of suspending them in the air.

3. The patient is made to rest on his knees and elbows, with his belly downwards, and his head bent between his arms. At the end

of seven or eight minutes, more or less, he feels the intestine return of itself. (Winslow.)

4. He is laid on the side opposite to that on which the hernia is situated. Often the hernia re-enters spontaneously. (Dalesme.)

II. COMPRESSION.—It has been advised to place on the hernial tumour a flat iron, a bit of lead, or a bladder filled with mercury. Velpeau, in a case of enormous entero-epiplocele which he could not entirely reduce, put the entire tumour in a suspensory bandage furnished with compresses, and in this way exercised on it an exact and strong pressure, which during the night reduced half its size, and rendered the reduction of the other half by the taxis easy and successful.

III. THE TAXIS.—The taxis is performed in one of the above positions; or, if the reduction is very easy, the patient may be allowed to stand. Unless some objection offers itself, we should attend to the following general rules:—

1. Evacuate the bladder, to augment as much as possible the capacity of the belly.

2. Recommend your patient to breathe freely, without crying out or raising his head—in fact; not to make the least effort.

3. Make at the commencement but slight pressure, so that you may afterwards augment it by degrees, and continue it longer without bruising the hernia.

4. Return first, the parts that last protruded.

5. Return them in the same direction as they came out; for instance, in recent inguinal hernia, push the intestine first directly backwards, to get through the first ring; then backwards, upwards, and especially outwards, according to the course of the canal; and, lastly, again from before backwards when you think you have reached the second ring. In congenital or long-standing hernias, it suffices to push the parts backwards and a little upwards.

6. Lastly, in certain exceptional cases these general rules fail, and the patients themselves are in the habit of using some special way or means, to which it is better to have recourse. There are three principal proceedings.

1. The surgeon seizes the hernia with one hand, in such a way that the palm of the hand presses on the base, and the fingers all round the neck of the tumour. He raises it in this way, and pushes it in the direction of the ring, compressing with his fingers the part next the ring, so as to diminish it to a suitable diameter.

2. He embraces the hernia with one hand or both (according to its volume), exactly applying his fingers on its entire surface, so that if possible no portion may remain uncovered, and presses all parts of the circumference of the tumour towards the centre. The efficacy of this pressure is augmented by, as it were, drawing the tumour out from the belly, and carrying it from one side to the other, compressing it with your fingers so as to unfold the portion of intestine contained in the ring, and cause the wind and fæces, that engorge the hernia, to re-enter the belly.

3. He leaves free the bulk of the tumour, but applies one or two

fingers close to the ring on the sides of the hernial sac, and pushes thus across the ring the part immediately next to it. When you have in this way returned a small portion, keep it back with the fingers that pushed it in, and push up another, but with the fingers of the other hand, and so on. It often happens that when the strangled portion, which formed a sort of plug, is returned, the rest follows easily.

This proceeding, especially suited for small hernias, is dangerous if the parts contained in the ring are already strangulated and painful. Its efficacy is augmented by bending the trunk backwards so as to enlarge the ring by the tension of the muscles of the belly. (Richter.)

When the hernia re-enters, if it is an enterocele, you are warned of it by a very recognizable gurgling noise, "gargouillement." In epiplocele, and even in obstructed enterocele not containing gas, this gurgling is not perceived; but you are made aware of the reduction by the vacuum you feel in the sac, and by the freeing of the ring. Keep it firmly back until the bandage or truss is applied.

It has also been advised to apply on the abdomen large cupping glasses, to draw in the protruded intestines, and to prick these latter with a needle or trocar, to give vent to the gas. The first method is given up, perhaps without reason; the second would not be without danger.

Appreciation.—Before anything else, the taxis should be tried; and neither of these three proceedings should be rejected—one may assist the other. But in difficult cases you may add to them compression with a bandage, after the manner of Velpeau, and especially position; you may try each of the various positions already mentioned. It remains for us to make known three other modifications which seems to us to deserve serious attention.

M. Ribes takes a mattress, folded and doubled up, so that the edge of the superior fold passes a little beyond the edge of the inferior, and that the surface of the mattress describes a very oblique plane; one or two bolsters are put under the doubled end of the mattress, to increase this obliquity, and the whole is covered with a sheet. This done, the patient is placed on the bed, with his buttocks on the edge of the mattress, and his thighs stretched out and in a line with his belly, and with his pelvis much elevated, and his diaphragmatic region as low as possible. His head must be supported with a pillow, and he must keep in this position all the time required. Then the taxis is tried; and, between each attempt, a bladder of ice kept on the tumour.

Amussat gives his patient a similar position, but, in addition, he flexes the thighs to relax the abdominal muscles, and inclines the entire body to the side opposite the hernia; and, lastly, whilst he is performing the taxis, an assistant keeps up a gentle traction on the belly, trying to draw it to the healthy side, and raises from time to time the parietes of the abdomen, slightly pinching up the skin. But what is more important, M. Amussat continues the taxis during two, three, or four hours, or even more, and has by these means reduced hernias that seemed only curable by operation. It is an admirable method,

when you are sure the intestine is free from gangrene ; but one to which recourse must not be had when the duration of the strangulation, or the rapid progress of unfavourable symptoms, gives us reason to dread this fatal termination.

Lastly, M. Koehler applies a cupping-glass on the hernia itself, to draw outside a large quantity of intestine, and especially disengage the strangulated portion. This proceeding has seemed to him to greatly facilitate the reduction.

Operation of cutting the Stricture, or Herniotomy.

Ordinary Proceeding.—The patient is laid horizontally, the parts being first shaved and well cleaned, and the abdominal muscles sufficiently relaxed ; but the thigh must not be so flexed as to incommode the operator.

The latter stands on the right side, or kneels or sits, if necessary. He raises the skin that covers the hernia in such a way as to have a fold as wide as possible, crossing at a right angle the largest diameter of the tumour ; he confides one end of this fold to an assistant, and, holding the other with his left hand, divides it to its base, either by puncture from within outwards, or, what is better, by incision from its free border to its base. This incision should remount half an inch above the ring, and descend to the base of the tumour, following its longest diameter. If it is not made long enough by this cut, the operator seizes one lip, and the assistant the other, separates them, and, slightly reversing them outwards, enlarges the wound with a bistoury as far as necessary. It is not of much consequence if the incisions here are terminated by tails.

The vessels opened by this first step are not of any size ; it suffices generally to pinch or twist them, or an assistant may place his finger on them.

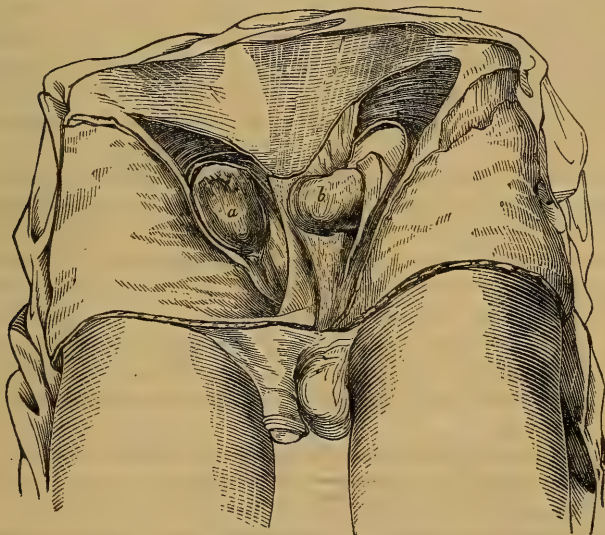
The second step consists in laying bare the hernial sac. The cellular layers that cover it must be divided cautiously and lightly—the safest way is to take up a bit at the most prominent part of the tumour with a fine forceps, and slice it out with a bistoury. Then pass a director upwards and downwards through the little opening made, and divide the layer on it to the ends of the wound. You proceed in this way down to the sac, which is sometimes separated from the skin by but a very thin layer ; at others, half an inch or more deep. The parts that constitute this thickness vary ; they may be lardaceous layers, circumscribed or diffuse purulent sacs, interposed adipose masses that simulate epiploon, cysts resulting from an old hernial sac, or of any other nature, &c. ; so that the diagnosis is sometimes very difficult, and we must proceed with great circumspection. Another circumstance adds importance to this precept. The spermatic cord may be entirely in front of the tumour ; in cases of old hernia also, its component parts are all scattered about, and you will see how important it is that neither the spermatic cord nor vas deferens should be wounded.

In doubtful cases the surgeon should not incise until he has assured himself of the nature of the parts by his eye and finger. He will distinguish cysts, abscesses, &c., by their want of communication with

the abdomen. If a fatty layer simulate the epiploon, tear it with the back of the director so as to expose the subjacent parts. In fine, you see that you have not opened the sac until you have under your eyes the smooth and polished surface of the peritoneum, and so long as the sound cannot pass round the tumour to the ring. Oftentimes the sac contains a certain quantity of serum, which greatly lessens these difficulties.

The sac being exposed, if there is no projection anywhere in it, you open it below, in front, and a little to the outside; the director is then passed into it; and it should be freely divided upwards as far as the ring, and low enough not to leave any *cul-de-sac* for the pus to accumulate in.

Fig. 20.



Hernia:—*a*, an oblique; *b*, a direct inguinal hernia. From a cast in the Museum of King's College, London.

The protruded parts then show themselves; sometimes they are united by recent false membranes: these may be destroyed with the finger; or, if they are of long standing, with the scissors. Extensive and intimate adhesions only should be respected. Then you seek the situation of the strangulation. I have already said that, in hernias which traverse the canal, the veritable strangulation has never been found anywhere but at the neck of the sac; but this neck may be found at divers heights, very rarely below the external ring; frequently on a level with this ring, especially when the canal is obliterated; but most usually near the internal ring; and sometimes a badly performed taxis has reduced the sac, neck and all, into the belly. You should remember also that in the living subject it is almost impossible to decide beforehand whether a hernia is oblique or direct; the latter of which may be easily strangulated by the fibrous opening that

gives it exit. In order to afford a positive diagnostic, it has been proposed to draw out if possible all that portion of intestine comprised in the inguinal canal; if not, it is better to expose and lay bare the entire pedicle of the hernia, to reach the precise seat of the strangulation. If the hernia had retired altogether, make your patient cough to reprotrode it.

The strangulation being at length recognized, use, for cutting it, a narrow button-pointed bistoury, convex or concave, guarded to within a few lines of its end, and directed on your index-finger (Dupuytren). The nail of the index-finger is first passed between the intestine and ring to be divided; its soft part then serves as a guide for the bistoury, the button of which is pushed beyond the strangulation, and if necessary into the belly, before its edge is turned towards the resisting border. An assistant then keeps the intestines away from the edge of the knife; and another if necessary holds apart the edges of the wound; after which the surgeon, suiting the movements of his right hand which holds the knife to those of the index-finger that guides it, presses in a sawing manner on the constriction until it yields with a noise like that of torn parchment; at all events when an aponeurotic ring is operated on.

When the strangulation is situated on a level with the external ring, or when the neck of the sac has been drawn outwards, there is no artery to be afraid of, the dilatation may be made in any direction; and, if made directly upwards, it is only for convenience. But if the neck remain buried in the inguinal canal—if the strangulation is situated at the internal ring—if the two rings, brought together by the effect of the hernia, are as it were confounded—if, in fine, there are several necks scattered about in the course of the canal, the incision must penetrate even into the abdomen, and then serious difficulties show themselves.

You cannot in any case make your incision downwards, for fear of wounding the epigastric artery if the hernia is external (or oblique), and the spermatic cord if it is internal (or direct). Upwards, and to the outside, you would meet the epigastric artery if the hernia is direct, upwards and inwards if oblique.

Chopart and Desault wished to distinguish these two cases: when the cord is behind, or on the inside of the tumour, the hernia is external (oblique), according to them, and the artery is on its inner side. In the opposite case the artery is on the outside and the hernia internal (direct). But these relations being very subject to variations and error, J. L. Petit and Scarpa, and after them Richerand, Dupuytren, and Sir A. Cooper, advise incising directly upwards. This proceeding may also, doubtless, sometimes expose the artery to be wounded; but it gives more guarantees for its safety than the preceding; and even if it does pass in front of the knife, its very oblique direction allows it to yield before, and avoid, its edge.

Again, the artery being always at least two lines to the outside of the ring, it has been recommended not to carry your incision beyond this extent. But, as so slight a dilatation is often insufficient, you may choose between a more extensive incision, still preferred by Du-

puytren, or the multiplied dilatation of Scarpa and Petrunti. This method consists in making two, three, five, or even ten small incisions round the constricting edge, each to a depth of one or two lines. For inguinal hernia the first incision should be made upwards, the second and third outwards, and the others (if they are required) inwards.

It remains to reduce the displaced parts, when healthy, by the rules for the taxis already laid down. It has been disputed whether the sac should also be returned; we can neither see the necessity nor utility of so doing. There are also two principal modes of dressing; some cover the bottom of the wound with dressing and stuff it with lint, others unite by first intention. But it may be seen that union by the first intention does not succeed here so well as in other wounds, and its opponents accuse it of causing accidents, abscesses for example. Perhaps also the other mode of dressing, exciting suppuration, and the formation of an inodular tissue, gives more chance against the return of the hernia. If the intestine is sphacelated to a small extent, the gangrened part must be retained on a level with the wound, whether it has already formed natural adherences, or whether it be necessary to retain it by threads. Moreover, reunion takes place spontaneously, and five or six weeks suffice for the cure.

If the epiploon is sphacelated, you act as for abdominal wounds, without reducing it; that which remains, after separation of the eschar, will better plug up the opening.

Lastly, if gangrene occupies a large portion of the intestine, you may retain the two healthy ends at the ring, to obtain a curable artificial anus; or excise the gangrened portion from the healthy, and proceed immediately to reunite by the plans indicated.

Proceeding of B. Bell.—This proceeding is intended to avoid the vessels, by dividing the tissues from without inwards. A scalpel with a broad or blunted point, its back resting on the left index-finger, is passed in front of the ring, and divides it in little cuts, fibre by fibre, from below upwards, or from the centre to the circumference, and from its cutaneous towards its peritoneal surface, taking care that the point of your nail always passes a little beyond the end of the knife. B. Bell, who admitted of but one ring, and supposed the strangulation to be generally caused by this ring, in this way removed it before reaching the artery or peritoneum. It seems, in fact, that sometimes incision of the ring only has sufficed to render the reduction easy, which may be accounted for in case of strangulation by merely an aponeurotic fissure. Moreover, if, after this section, the strangulation continues at the neck, you would divide it in the ordinary way, or on a director.

A great number of proceedings, or of variations on proceeding, have been proposed for the operation of dilatation, or cutting the stricture. To J. L. Petit is owing the idea of dilatation without opening the sac, renewed by Bonnet of Lyon.

M. J. Guérin has gone still farther, and has proposed to free the intestine, subcutaneously, the knife being introduced under the skin by a simple puncture; this is a rash proceeding, and one which I look upon as absolutely impracticable in a case of veritable strangulation. In my own practice, I give the preference to the proceeding beneath; several elements of which way be found scattered about in books.

Author's Proceeding.—I make my incision, not on the sac and scrotum, but on the place where the strangulation appears to be situated, prolonging it upwards and downwards to the extent required by the *embonpoint* of the subject, and the size of the hernia. All the tissues are divided in the same way down to the peritoneum; and, as we thus expose and lay bare the vessels, we put them aside, and have nothing to fear from them. If you find that the strangulation is caused by a fibrous opening, you need not open the sac, but reduce the hernia. If not, the neck is divided from without inwards, carefully and gently; or, if the stricture appears very strong, you make a small incision in the peritoneum, either above or below the neck, which you then raise on a director, and divide.

In this proceeding, I find the great advantage of being able to see everything as I go on. Secondly, I reach the strangulation by the shortest way, and with the least possible incision. Thirdly, I leave untouched the scrotum and sac, and consequently am not troubled with the cicatrization and suppuration of a wound, at all events useless. I lately performed it for a large scrotal hernia; the neck of which was situated on a level with the abdominal ring, the sac which I had respected, though I opened its neck, filled in the first few days with a certain quantity of liquid, which was reabsorbed as the inflammation of the superior wound went down, and the patient was cured without accidents.*

(2.) *Crural Hernia.*

Surgical Anatomy.—The crural ring is a triangular opening, circumscribed above and in front by Poupart's ligament; below and behind by the superior surface of the body of the pubis, covered by the pectineus and its fibrous sheath; on the outside by the psoas and iliacus muscles, or rather by the fascia that covers them; the internal angle, the only one that deserves notice, is rounded off and formed by the ligament of Gimbernat. This opening gives passage to the external iliac artery and vein placed to the outside, and a little behind and below. At their internal side is found a sort of passage occupied by

* "In the operations above described (for inguinal and crural hernia), the ordinary method of opening the sac has been recommended; but in large protrusions it would unquestionably be highly desirable to return the contents without thus exposing the peritoneal surface. In the majority of such cases, the stricture may be divided without penetrating the sac; but in some instances, even after this has been done, the protrusion cannot be returned in consequence of adhesions. Even in small herniæ, it has been Petit and Monro; and, in more modern times, has received the sanction of Sir A. Cooper, proposed to relieve the stricture without opening the sac. The practice was resorted to by Mr. Key, Mr. Lawrence, and other surgeons of distinction. I am not aware, however, of any practitioner of the present day having had such experience in this mode of procedure as Mr. Luke of the London Hospital. In a conversation which I lately had on the subject with that gentleman, he informed me that his operations had been very unsatisfactory in their results until he adopted the plan in question, when he found that, instead of losing every third patient, or about that average, he had only lost two out of nearly forty on whom he had operated without opening the sac. Experience such as this ought, assuredly, to have great weight; and should, along with Mr. Key's excellent Memoir, go far to attract still greater attention to the practice. The cicatrix in these individuals gives no security against a second protrusion."—Vide *Fergusson's Prac. Surgery*, p. 525.

cellular tissue only, and sometimes a lymphatic ganglion; closed superiorly by the peritoneum, and a fibrous layer called the crural septum; having for its posterior wall the sheath of the vessels and the aponeurosis of the pectineus, for its external wall the cribriform layer of the fascia lata; and terminating two-fingers' breadths below by an oval orifice, corresponding to the junction of the saphena with the crural vein, and looking inwards and forwards. It was thought that

Fig. 21.



Crural Hernia:—*a*, intestine; *b*, peritonæal membrane; *c*, fascia propria; *d*, absorbent glands; *e*, anterior border of Poupart's ligament; *f*, fascia lata; *g*, saphena major vein; *h*, superficial epigastric vein; *i, i*, superficial epigastric arteries; *k*, external pudic; *l*, situation of Gimbernat's ligament; *m*, lymphatic vessels; *n*, middle anterior cutaneous nerve.—From *Morton on the Groin*.

crural hernia usually came out through this opening, but that is by no means exactly true. Very often the hernia remains shut up in the crural canal without coming to the outside; and when it does come out, it is frequently at a fibrous rent or fissure, situated at the point of union of the cribriform lamella, with Gimbernat's ligament; it is often also by one or more of the holes of the cribriform layer, in such a way as to present externally two or three projections. Hesselbach has described a hernia that protruded by five holes at once.

For a more lengthened and extended study of this canal and hernia, I refer you to my *Surgical Anatomy*.

Crural hernia resembles inguinal hernia in its composition; it has been remarked that in it the omentum frequently covers the intestine; sometimes the cæcum or sigmoid flexure of the colon may be engaged in it by their extra peritoneal portions, so as to form a hernia without any sac. When it has protruded through any external opening, it has a tendency to remount on the abdomen; either on account of the movements of flexion of the limb, or because of the greater laxity of the subcutaneous cellular tissue on this side. It is then covered only by the skin, lymphatic ganglions, and the three layers of the superficial fascia.

The strangulation may be situated at the superior orifice of the canal, or in the canal itself, or at the external orifice; but it is important to notice that, in the first two cases, the neck is always strangulated; whilst, in the last, the strangulation is generally determined by the fibrous opening that gives passage to the hernia. The relations of the vessels with crural hernia must also be studied. We have already pointed out the relations of the iliac vein and artery with the canal, and, consequently, with the hernia. At the inferior opening the saphena vein is also found at the lower part of the tumour, at the superior orifice; the epigastric artery, springing from the iliac, runs from below upwards, along the outside of the crural ring; the spermatic cord, with its artery, runs along its upper and internal side, from which it is separated only by the hollow of Poupart's ligament; the inferior side is constituted by the pubis; the only part that is free is then the internal angle, occupied by Gimbernat's ligament. But in a great number of cases the obturator artery arises from the epigastric, and descends behind this ligament. The epigastric has also been seen to arise from the obturator, and follow the same course as it ascended; these arteries also send to each other anastomotic branches that pass behind this ligament, so that to those who admit strangulation by the crural ring, the operation is horribly uncertain; since you can never be sure that the ring is not surrounded with an almost complete circle of vessels. But we must say, and repeat, that strangulation by the crural ring has never been demonstrated, and that it even seems impossible, in the great majority of crural hernias, on account of its breadth in comparison with the small size of the hernia; and then the dilatation having only to be made on the neck, or on the fibrous openings pointed out, you are generally far enough off from the vessels.

1. *Palliative Treatment*.—The bandage or truss for crural does not differ from that for inguinal hernia, excepting that its neck should be shorter. The pad is continued in a straight line with the spring, and should be oval and narrowed from above downwards, not to incommode the movements of the thigh.

2. *Radical Cure*.—Almost all the methods proposed for inguinal hernia have been advised here also. Mr. Jameson invented his method for crural hernia especially.

3. *Proceedings for Reduction*.—All the proceedings applicable to inguinal hernia are so to crural also; only that you are advised to flex

the thigh on the pelvis when you wish to relax the ring, and to abduct it to relax at the same time Poupart's and Gimbernat's ligament. As to the direction in which you must act, if the hernia has reached the exterior, you can have no doubt about following that of the canal : commence by collecting the protruded parts at the external orifice ; then push them back, at first from before backwards, and slightly from within outwards, then directly upwards, and, lastly, at the same time upwards and backwards. But if the hernia is internal, or even if, being external, it has enlarged the opening and effaced the anterior wall of the canal, this latter has then but the one direction, which is oblique from below upwards, and from before backwards. It suffices then to push back the intestine by this way.

Operation of Dilatation, or Cutting the Stricture.—All the details of the operation for strangulated inguinal hernia apply to the same operation for crural ; we shall only point out the modifications rendered necessary by the anatomical relations.

The incision of the integuments is made in the direction of the fold of the groin, and of the great diameter of the tumour. One simple incision generally suffices ; but, if the hernia is very large, you may transform it into a T, dividing, as required, the superior or inferior lip of the wound, or even both, so as to give a crucial incision. It is sometimes difficult to raise the skin for this first incision. You then use a scalpel, held in the fifth position, with all possible gentleness and precaution. The sac being opened, and the situation of the strangulation made out, it is a question among surgeons in what direction the incision must be made. Sharp cut outwards and upwards ; Pott directly upwards ; Sabatier upwards and inwards ; Gimbernat inwards, on the ligament that bears his name, grazing the superior surface of the pubis ; Scarpa had recourse to multiple incisions, making three or four on the inferior border of the crural arch ; Sir A. Cooper made a small incision parallel to this arch, and a little above it, put aside the spermatic cord from the edge of the instrument by means of a curved director, and fearlessly divided the border of the ring beneath it ; Dupuytren cut from within outwards, and from below upwards, parallelly to the spermatic cord, but by a very different proceeding to that of Sharp. He used his probe-pointed bistoury with a narrow blade, convex on its cutting edge, and divided the tissues from the outside inwards, as Bell did for inguinal hernia.

You will at once remark, that if the strangulation is situated at the ring, as is generally believed, the proceeding of Sharp would conduct the instrument directly on the epigastric artery ; those of Pott and Sabatier on the spermatic cord in the male, and in both sexes on the obturator artery, in case it arises from the epigastric. That of Gimbernat would not escape this last danger. There remains then the proceedings of Scarpa, Sir A. Cooper, and Dupuytren ; nevertheless, we do not see or hear that before their time these lesions were more frequent ; and, altogether, I am led to believe that they are much more rare than you would suppose from the writings of authors, and especially of anatomists.

According to what we have said above, the strangulation not tak-

ing place at the crural ring, the fears and precautions of operators are without foundation in the greatest number of cases. When, for example, the hernia is strangulated at the saphenous opening, you may cut it freely upwards or at the inside; if it is strangled at the neck, and the neck can be drawn out, nothing can be more simple. There remain some more embarrassing cases. 1. When the neck of the sac adheres to the neighbouring tissues as high as the crural ring; in this case, after having well exposed the situation of the strangulation, you have only to apply your index-finger on the crural artery and vein to protect them, and you may cut outwards or inwards fearlessly, or on each side, after the method of Scarpa. 2. When the hernia has traversed the fibrous opening situated between the ligament of Gimbernat and the origin of cribriform fascia, protect the vessels, and you may cut outwards with security. 3. If the hernia traverses Gimbernat's ligament itself, it is impossible to say whether there exists an abnormal obturator artery, or on which side it is. If, on the contrary, the hernia has commenced outside the crural vessels, the neck of the sac may be found outside the epigastric artery, and the surgeon has not beforehand any indication to direct him. But these cases are excessively rare, and have not been foreseen by any of the proceedings described; nevertheless, you may escape all danger by following as much as possible this general principle, which I have laid down as a rule for the operation for hernia—*always lay bare the seat of the strangulation, and never cut anything without having first well recognized it.*

Moreover, in these embarrassing cases, and especially when the strangulation is determined by an aponeurotic rent or fissure, I would advise first trying simple dilatation of the opening already advised and put in practice successfully by Leblanc; and I would never have recourse to the knife but in a case of absolute necessity. The instrument required for dilatation is very simple; I merely had the points and edges of an ordinary small spatula blunted. The end of this I passed between the constricting ring and intestine, and, grasping its handle, pressed on the circumference of the ring to tear and enlarge it; there is then no fear of wounding the vessels or injuring the intestines. This plan I used in a case of crural hernia strangulated in an opening of the cribriform fascia. Perhaps, even, it would not always be necessary to proceed to dilatation or incision, did we try the taxis on the intestines laid bare by incision of the sac.

(3.) *Umbilical Hernia.*

Surgical Anatomy.—The umbilical ring, traversed by the vessels of the same name and by the urachus, is but slightly resistant and very dilatable for some time after birth. It contracts with age, and becomes obliterated in a solid manner—a circumstance that has been taken advantage of. The peritoneum is here so adherent to the parietes of the abdomen that the existence of a hernial sac has been denied, and that it is difficult to isolate it during the operation. The vessels are not much to be feared; the umbilical arteries are obliterated immediately after birth, the umbilical vein a little later. In any

case, you know that the first runs downwards towards the fold of the groin, and the second rises a little towards the liver and the right side.

The taxis has nothing peculiar about it; the course of the hernia being only one simple ring, it must be pushed directly backwards. The palliative method is compression: the radical cure may be obtained by compression and ligature of the hernial sac.

I. COMPRESSION.—The trusses have varied. Sometimes a simple elastic girdle is used, or a girdle with a pad. Quadri advises the following apparatus for obtaining a radical cure.

1. *Truss for Children*.—After the hernia has been reduced, a small hemispherical gum-elastic pad is applied on the ring, and kept in situ by an elastic girdle, or by a simple folded silk handkerchief. The gum-elastic pad, by means of the humidity, sticks firmly to the skin, and even retains its position when the movements of the child displace the girdle. Hey made a similar pad with circles of adhesive plaster spread on leather, and placed one on the other, so as to represent a cone.

2. *Truss for Adults*.—The hemisphere is replaced by a gum-elastic tube, at most an inch and a half long and two-thirds of an inch in diameter; applied horizontally on the ring, and maintained by the same girdle. This apparatus should be worn for a year, or even two or more. With either apparatus, the pad should always be a little smaller than the ring, with the double object of pushing the intestine well back, and leaving room for the ring to contract on itself; also, as this contraction goes on, the pad should be diminished.

I have tried these apparatuses, and other analogous ones, but always without success. In adults it is almost impossible to obtain a radical cure, and the best bandage consists in a pad of pure caoutchouc cut to the shape of the umbilical ring, covered with chamois leather, resting on a small spiral spring, and fixed by a large spring passing half round the body. Young children cannot wear a spring truss, the conical shape of the abdomen making it always slip towards the hypogastrium. I use a flat oblong plate covered with wool, and fixed by a simple bandage; and over the bandage I apply a long strap of diachylum, passing once and a half round the body, without touching the skin.

II. LIGATURE.—Known for this long time, and performed on the sac, either after having opened it, or upon the skin. This latter proceeding was adopted by Desault and Dupuytren.

Proceeding of Desault.—The infant being laid on its back, with its head bent on its chest, and its thighs flexed on its pelvis, the surgeon reduces the hernia, retains it with his left fore-finger, and, with his right hand raising the parietes of the hernial pouch, he slides them between his fingers to make sure that no part remains in the sac. Being assured of this, his assistant makes several turns round the sac at its base with a waxed thread, each turn being well tightened, and secured by a double knot. The tumour thus tied is enveloped in a bed of lint, maintained by a compress and bandage. On from the eighth to the tenth day the ligature falls off with the parts it has strangled and killed. A small ulcer results, which is soon healed. It is

well for the child to wear a bandage for two or three months, the better to prevent a relapse.

When the hernia becomes strangulated, it is laid bare by a longitudinal or T incision; the sac is cautiously opened, and incisions made upwards and to the left. In cases where the hernia is large, the incisions should be made as much as possible without opening the sac, not to expose the peritoneum to the contact of the air. With the same end in view, seek reunion by the first intention by means of strapping or points of suture. (Lawrence.)

Abnormal Anus.

Anatomy.—Abnormal anus results from a loss of substance in the intestine, with fistula through the abdominal parietes. Sometimes this fistula is multiple and composed of several small openings, more or less remote from that of the intestine; sometimes there is but one opening. The disposition of the ends of the intestine varies; sometimes the upper end only opens at the wound, the inferior remaining concealed in the belly, and then no operation can be attempted. Sometimes the two ends present themselves at the exterior; and, if the loss of substance only affects part of the calibre of the intestine, they form at their point of union an angle more or less acute, and are in apposition to a greater or less extent. The common septum, that results from this apposition projecting into the calibre of the intestine, forms a kind of valve, which hinders the free passage of the fæcal matter from the superior into the inferior end.

The angle is much more acute, and this apposition more prolonged, when a portion of the entire circumference of the intestine has been destroyed; the two ends are parallel in a greater or less extent: the end of the septum that separates them completely hinders the passage of the fæces from one end of the intestine into the other; this projecting edge is called the spur, "*l'éperon.*"

In an abnormal anus of long standing another phenomenon is observed—the two ends of the intestine retract inwards. Scarpa explained this by a movement of traction exercised on them by the mesentery, which movement we think is owing solely to the peristaltic motions of the intestine. There is then formed a membranous canal from the intestine to the surface, called the funnel, "*l'entonnoir,*" which serves as a way of communication between the two ends of the intestine; and when the spur is not very prominent, but strongly retracted, it ends by bringing about the complete return of the fæcal matters into the inferior end, and the spontaneous cure of the artificial anus. Lastly, the artificial anus may be complicated with eversion of the superior end of the intestine, and even of both ends at once. The treatment is either palliative or curative.

Palliative Treatment.—It consists in stopping up the external opening with some kind of plug, until the patient feels it necessary to go to stool; or in supporting the edges of the opening by a circle of ivory or steel, covered with oiled silk, and pierced in the middle with a hole easily corked; or in adapting to it an ivory or metallic receptacle, supported by a bandage; or in making the upper end of the intestine

communicate with the lower by means of a gum-elastic tube, two or three inches long, and slightly curved, the concavity of which bearing on the spur and pushing it back, may favour the radical cure; its concavity may be fixed opposite the wound with a thread. (Colombe.)

Curative Treatment.—This treatment comprises three distinct steps; the first destined to destroy the complications, and bring the disease to a suitable state of simplicity; the second to destroy the spur; and the third to obliterate the external wound.

1. If there are several openings they must all be united into one, or the tumour in which they are comprised must be removed. Eversion of the intestine is reduced by the ordinary taxis performed in the horizontal position. If the everted end is tumefied, envelop it in a bandage (*en doloires*), keeping up a well moderated pressure, diminished from the summit towards the base of the tumour (Desault). If strangulation is combined with the eversion, cut the stricture, carrying your bistoury at the root of the tumour, between it and the skin, and dividing upwards successively the skin, aponeurosis, and muscles. Lastly, it is often necessary to dilate the fistulous passage that conducts to the base of the funnel, which may be done with sounds of caoutchouc, bits of gentian root, cylinders of prepared sponge, &c. This last is the most speedy method; but Delpech has observed that it causes more pain because the granulations vegetate into the pores of the sponge, and must be torn when you would extract it. It would be easy to avoid this inconvenience, by wrapping the sponge in a piece of linen. Sometimes also it is well to free it a little with the knife.

2. When the spur is the sole obstacle to the passage of the fæces, the obvious treatment is to push it back, or destroy it. For the first purpose *mèches* of lint have been used (Desault). But the second method, imagined by Smalkalden, and improved by Dupuytren, has been generally adopted.

Proceeding of Dupuytren.—The *enterotome* of Dupuytren is composed of two separate branches; one of which has on one side of it a groove large and deep enough to receive the sharp edge of the other; the bottom of this groove is undulated, and the edge of the branch that is to fit into it presents corresponding undulations, so as to augment the surface on which the instrument should seize. These two branches may be united at pleasure, by means of a movable pivot fixed to the recipient branch, and received in a hole prepared for it on the other. Beyond the point of union each has a handle, which handles are brought together by a screw vice. The instrument is altogether six inches and a half long; and the branches destined to penetrate into the intestine are three and three-quarters.

In the first place, you must expose the two orifices of the intestine, which is sometimes very difficult to accomplish. The patient is placed as for the operation for strangulated hernia. The upper end shows itself well enough by the presence of the fæcal matter; and if you can recognize the spur, you can easily find the lower. But the disposition of the ends of the intestine renders the introduction of a finger difficult. In this case you supply its place with two female sounds, passing one into the upper and the other into the lower end of intes-

time; if you then try to turn them one over the other, the pain caused, and resistance felt, show that you are stretching and dragging the septum.

When you have well recognized the position of the two ends, take one of the branches of the enterotome in your right hand, and pass it along the female sound, or along your index-finger, into one end of the intestine, two inches deep or more, according to the projecting of the spur. Give this branch to your assistant to hold, and pass the other in the same way, to the same depth, into the other orifice; then unite them by their pivot, and gradually bring them together by means of the screw, which you tighten each time that its branches seem to loosen. Each fresh turn of the screw causes colics of short duration, and rarely any more serious accident. The effect of the enterotome is easily understood. It augments the length of the parallelism of the two ends of intestine, extends their intermediate septum, and by its pressure on this septum, determines, first, solid adherence of the two sides, and, afterwards, complete division of the parts between its teeth.

About the eighth day, sometimes even before, it becomes movable, and falls off; you then find in the bottom of the groove a brown dry eschar, undulated, and of the same length as the loss of substance occasioned in the intestine. On introducing your finger into the fistula, you recognize the remainder of the septum by its hard and undulated edges. A wide communication has now been opened between the two ends of intestine; and you should, by means of repeated lavements, favour the passage of the fæces into and through the lower end.

M. Liotard has proposed another instrument, each branch of which has at its extremity an oval ring one inch and a half long, and two-thirds of an inch wide; one being grooved to receive a corresponding projection of the other. The two branches only touch at the rings, so that they detach an elliptical portion of the septum at a spot some way off from the free edge of the spur; and the excrements pass through the new opening without approaching the external fistula.

M. Jobert proposes to apply the enterotome only to procure adherence of, and not to divide, the septum. After forty-eight hours the adhesions would be formed and the instrument might be withdrawn. A day or two longer would be given for the adhesions to become solid; and then the septum should be divided with a graduated scissors, as far as required, but without passing beyond the adhesions. Experience has not yet shown the result of this proceeding, but it seems to us worthy of trial.

3. It remains to close the external opening, which is often very difficult. Compression, cauterization by nitrate of silver, approximation of its edges by a kind of vice, suture, &c., have all been tried without much success. M. Collier proposed autoplasty by the Indian method. I also pointed out, as likely to be of use, the different proceedings of the method of Celsus, or the proceeding of Jameson. Velpeau has tried all these methods without success. He thinks that Reybard's proceeding for suture of the intestines might be of some

service; it consists in comprising in the loops of thread a plate of wood placed in the intestine behind the wound, to hinder all communication between the interior and exterior; but he has not yet tried it, and he has succeeded well with the following proceeding.

He excised the whole of the external fistula by two semilunar incisions, forming an ellipse, oblique from the sides towards the centre, and made so as not to touch the intestine, or at all events its mucous membrane. He passed in four points of suture, about two lines from each other, taking care not to allow them to reach the peritoneal cavity or intestine. Then an incision about three inches long through the integuments, and the aponeurosis of the external oblique was made on each side, an inch below the wound, to render the approximation of the edges of the fistula easy, and the strain on the sutures less, according to the rules laid down by Celsus. Having then washed and cleansed it, the surgeon tied the threads, and placed a bit of lint in the lateral wounds to prevent them from reuniting. By this proceeding the fistula is transformed into a conical cavity, its cutaneous portion cannot then be brought together without its intestinal portion being completely closed: and as the threads do not penetrate down to the gut, the intestinal moisture does not tend to exude by the passage.

CHAPTER VIII.

OPERATIONS PERFORMED FOR AFFECTIONS OF THE RECTUM AND ANUS.

Most of these operations are performed on the anus or rectum itself; but I have thought fit to class with them the formation of an artificial anus in the abdomen, which belongs essentially to the treatment of affections of the rectum.

(1.) *Fissures of the Anus.*

PALLIATIVE TREATMENT.—*Proceeding of M. Gossement.*—When the patient feels the desire to go to stool, he should moderately pinch, with two fingers, a portion of skin equivalent to almost one-sixth of the circumference of the anus, and comprising the fissure; at the same time pushing from within outwards, so as to enlarge the anal orifice, and give a new fixed point, not bearing on the fissure, to the sphincter; thus hindering the former from being dragged and strained by the passage of the excrements. In this way the pain is almost always avoided.

CURATIVE TREATMENT.—In addition to topical applications, whether narcotic or astringent, dilatation by mèches (which we need not describe), cauterization, and incision have been employed.

1. *Cauterization.*—A stick of nitrate of silver is cut to a point or angle, and laid in the ulceration during some minutes: one applica-

tion scarcely ever suffices; it must be several times repeated. J. Cloquet dips a pencil in liquid nitric oxide of mercury, and leaves it on the fissures for one minute.

2. *Incision.* (Boyer.)—This method is founded on the fact that the spasmodic constriction of the sphincter, which almost always accompanies the fissure, is the principal cause of the symptoms, and even determines them in the absence of fissure. He conceives that the best method to destroy it is to divide the contracted fibres, whether on the fissure or elsewhere.

Take care to empty the bowel beforehand by means of a purgative; and to administer a lavement the day you operate, so that the patient may rest some days without going to stool. Make him lie on his side; push your left index-finger, greased, into his rectum, and on it pass a bistoury with a very narrow blade, rounded at its extremity (Boyer), or simply a straight button-pointed bistoury (Richerand). The edge of this bistoury is then turned towards the side of the fissure, and the intestinal mucous membrane, the sphincter, the cellular tissue, and integuments are all divided in the same cut. There results a triangular wound, whose summit corresponds to the intestine, and its base to the skin. If it is necessary to elongate this latter, do it in a second cut. Sometimes the intestine glides away before the instrument, and the wound of the cellular tissue is longer than that of the intestine; in this case the bistoury must be again introduced into the rectum, to prolong the incision of the gut.

When the constriction is extreme, two similar incisions are made, one on the right, the other on the left. A mèche of lint is put in each wound, and it is then stuffed with lint, and a T bandage put on. The dressing is removed at the end of two or three days; it is then simply dressed until cicatrization is complete, which is in from a month to six weeks, sometimes later, more rarely on the fifteenth or twentieth day.

Appreciation.—Cauterization is often very painful, sometimes useless; incision, on the contrary, scarcely ever fails. The first should never be tried but on patients who dread the bistoury. The other means are less trustworthy still; but you may try them without pain, consequently without inconvenience.

(2.) *Fistula in Ano.*

Anatomy.—These fistulæ are divided into the *blind external*, which does not communicate with the intestine; the *blind internal*, which does not communicate with the exterior; and the *complete fistula*, which is a passage extending from the intestine to the skin near the anus. This passage, more or less oblique, or tortuous, is lined by a new formed mucous membrane, which prevents the adhesion of its walls. Often there are several openings on the outside, more rarely on the inside, and several little sacs communicating with the principal passage. The internal orifice is sometimes marked by a projection; but it is almost always smooth and not recognizable to the touch. It is met with generally between the skin and sphincter, or even in the tissue of the sphincter, and rarely higher up than an inch and a quar-

ter from the anus (Ribes). When it is beyond that, very often the intestine is separated from the neighbouring tissues to a certain extent.

The *blind external* fistulæ are treated by injection, and by compression; or their course is refreshed; or their external orifice is enlarged to give a free exit to the pus; or some portion of diseased callous skin is removed. As a last resource, the rectum is comprised in the incision of the fistulous passage.

Blind Internal Fistulæ should be made complete. The treatment of them, then, comprises several methods; compression, injection, cauterization, ligature, excision, and incision. Ligature and incision only are worth retaining.

I. INCISION.—The bowel should be open by a purgative over night, and washed out with a lavement on the day of operation. The patient is laid on the edge of a bed, on his right side, if the fistula is on the right, and vice versâ; the thigh that is undermost extended, the other flexed, the head inclined on the breast, and the belly lying on a bolster. One assistant holds apart the nates, others keep the patient quiet. The external orifice of the fistula is easily found by the stercoral moisture that exudes from it. When the internal orifice is situated in the middle of an induration like a hen's rump, or of an ulcer, the index-finger easily recognizes it. But when these indications are wanting, it is often very difficult to find it; sometimes you seek it too far away, whilst it is quite close to the skin; and you should always search the skin about the anus before you go any farther up the intestine. You may try injections of milk or colored water by the rectum, or by the external orifice of the fistula, or introduce a probe. This instrument penetrates easily when the fistulous passage is straight and simply; but when it is bent in several directions, or has many little pouches, the probe must be passed into each.

It often happens that the probe, passing freely nearly as far as the intestine, is stopped by the mucous membrane, which is felt detached, and cannot find the internal opening; nevertheless, the operation must be performed, and the fistula will heal just as well as if the incision had divided its two orifices; but the proceeding is then slightly different.

Ordinary Proceeding.—The two orifices of the fistula being found, and the internal not being very high up the intestine, the surgeon introduces, by the external orifice, a flexible director of refined silver, and at the same time passes his left index-finger into the rectum. When he feels the end of the director, which he presses against the tunics of the intestine, he seeks the internal orifice of the fistula, passes the director through it, and brings it out by the anus. The point of a bistoury is then passed along the director, its edge outwards, so as to divide in one cut, and from within outwards, all the parts raised by the director; that is to say the skin, intestine, and anus.*

* We usually make the patient kneel on a chair, and lean over its back. A probe-pointed bistoury is then passed into the external opening, through the fistula, and into the gut, to meet the forefinger of the left hand, which is greased and introduced by the anus; the blunt end of the bistoury is then kept well against the end of the finger, and both are brought out together; or the point of the finger may be put on the back of the end of the blade to push it out before it.—F. B.

Proceeding of Desault.—When the internal orifice is situated so high that the finger cannot bring out the sound by the anus, an ebony gorget, rounded on one half, and hollowed out on the other into a groove terminated by a cul-de-sac, must be introduced, having been first well oiled. After the sound has passed through the fistulous passage, as usual, its extremity is pushed against the hollow of the gorget, the two instruments being moved on each other to ensure their contact. Then the gorget is confided to an assistant, who holds it firmly, inclined towards the buttock. The surgeon seizes the director, conducts the blade of a straight bistoury on it to the gorget, and inclines its edge towards the latter, so as to cut as much with the blade as point, and use the instrument more by sawing than pressing. He then draws the bistoury to himself, without abandoning the gorget, and thus divides all that is comprised between the two, so that the fistulous passage and rectum are now only one. You make sure that the incision is complete by withdrawing together the gorget and director in contact. If any portion has not been incised, and stops them, the bistoury must be again placed in the director, and all three be brought out together, forming an angle, so that nothing can be left uncut that was comprised in the angle.

You would proceed in the same way if you could not find the internal orifice; the director being applied against the gorget, from which it is separated by the internal wall, you would use the bistoury as usual, and it would divide this wall; or you might use a steel sound rather pointed, which itself would traverse the intestine to be applied immediately against the gorget (Roux).

When the fistula is simple, this simple incision suffices. If the skin is more or less undermined, it must be cut and excised, to leave a flat wound; the denudation of the intestine below the incision requires that scissors should be introduced on the finger, to cut off the loose and floating portion. When there are several passages ending in one common orifice, they must all be slit up successively; and if the skin that separates is thinned, detached, or diseased, excise it. The callosities rarely need removing. It suffices to scarify them in different directions, suppuration then takes them off. Lastly, when the incision is made, if you see that the bottom of the fistula is uneven, and hollowed out by little sacs and passages without internal orifices, divide them widely. I have seen an operation for fistula in ano, in consequence of neglect of this precaution, leave the patient almost as badly off as before.

Sometimes the fistulous passage is so narrow that the director cannot traverse it; it should then be dilated with caustics, or substances that can expand (Boyer). Lastly, there may exist in the same individual several isolated fistulæ; you may incise them one after the other (Amussat); or, if they are near each other, begin by laying them all into one, dividing the septum that separated them, and then incise the rectum (Jobert). The dressing is here of great importance; the two lips of the incision should be held apart in their whole extent, by a mèche of lint; or, better, by a simple band covered with cerate to prevent their reunion, which would reproduce the fistula. The intent of

the operation is to make the fistulous passage and intestine into one canal.

II. LIGATURE.—You may use metallic threads, introduced alone, or by means of a director, or by the canula of a trocar, previously passed into the course of the fistula (Desault). When the end of the thread has penetrated into the intestine, it is brought out and twisted with the other, so as to strangle the parts to be divided; and the torsion and constriction may be augmented when thought necessary. It would be easier to introduce a bit of silk, by means of an eyed-probe of flexible silver; and, instead of the *serre-nœud*, recommended by some authors, the presence of which would be a great inconvenience, we advise simply to tighten the cord, either with a knot and bow, or with a double knot. In the latter case it would still be easy to augment the constriction by cutting the knot, attaching a fresh bit of silk to the end of the old ligature, and drawing it through as a seton.

Ligature is tedious and often painful, especially when the skin alone remains to be divided; then it is often necessary to have recourse to the bistoury; consequently, it is but a secondary means, and should only be employed on patients who are afraid of the knife.

(3.) *Of Hemorrhoidal Tumours.*

Anatomy.—Hemorrhoidal tumours are divided into internal and external, according as they are situated above or below the orifice of the anus. Sometimes isolated, at other times united in the shape of a circular excrescence, they are at first rounded, but with time become pediculated.

Their nature still remains a disputed question. Jobert maintains the old notion, that they are the same as varices; Ribes thinks they result from rupture of the anal veins, and the extravasation of blood into the cellular tissue; Abernethy attributes them to the transformation of a clot of blood into a vessel; some anatomists have pointed out the existence of a kind of erectile tissue in the excrescences, &c. But in general the tumour arises from a collection of blood, often black and clotted, in a sort of cyst, due either to a new formation, or to a varicose dilatation.

Internal hemorrhoids sometimes project externally, and become strangled by contraction of the sphincter: it is recommended then to reduce them by the ordinary taxis, unless the inflammation is too strong; in which case we have seen gangrene come on, and cure the patient. Might we not, in case of serious accident, cut the stricture at the anus, to facilitate their reduction?

As to the curative treatment, compression has been forgotten; ligature, incision, excision, and cauterization alone are retained. Whatever be the proceeding preferred, the intestine should always be evacuated, and the patient placed, as for fistula of the anus, on the diseased side; so that on raising the buttock on the healthy side, the hemorrhoids are exposed.

I. LIGATURE.—On pediculated tumours it is effected with a simple waxed thread, tightened by a knot and bow, or double knot; in fact,

it is easy to put on a fresh ligature when we wish to tighten. When the tumour is too large, it is traversed at its base with a curved needle, armed with a double thread, and the two halves are tied separately.

II. INCISION.—For a small tumour a lancet is used, with which an opening is made large enough to give free passage to the clot of blood it contains. When the tumour is larger, a bistoury may be used.

III. EXCISION.—The patient being placed in the proper position, and the tumours apparent on the exterior, seize them one after another with a double hook, or dissecting forceps, and cut them off near their bases with a bistoury, or with good scissors, when they have a narrow pedicle. When they occupy both sides of the anus, the operator should begin by the inferior half of the tumour, so as not to be incommoded by the blood.

Dupuytren, in all cases, seized them in a large-toothed forceps, and excised them with long scissors curved on the flat: a model of which he has given us. He took care to remove only a portion of the projecting part of the tumour, to avoid hemorrhage, and consecutive stricture of the anus. He left them a portion, apparently of considerable size, but which diminishes with the cicatrization, and leaves the anal opening in the normal condition. The difficulties of excision are greater for internal tumours. They must be made to come out completely, by placing the patient on a hot fundament bath, and telling him to make violent efforts of expulsion. When they have come out, immediately put him on his bed and operate. Dupuytren seized them and removed them entire, without any extraordinary precaution.

Boyer begins when the tumours are distinct and separated, by passing into each of them a curved needle armed with a loop of thread, or piercing them with hooks; but if, as usually happens, they form a large mass, divided into several portions, he passes a loop of thread into each portion. This is to prevent the pain of cutting off the first, causing all the other tumours to go back. These preliminaries being accomplished, the surgeon confides all the loops of thread to an assistant, with the exception of that which traverses the tumour to be first excised. He draws this latter towards himself, to make the tumour more prominent externally, and cuts across its base with a bistoury, the back of which he turns towards the centre of the anus; and in the same way removes the others successively.*

But if the tumours are of long standing, and bleed periodically, Boyer follows the advice of Hippocrates, and leaves one to serve as a vent. Stricture of the anus and rectum is prevented by the use of mèches, and especially by incising the sphincter after extirpation of the tumours. To do this the left fore-finger must be passed into the fundament, and a probe-pointed bistoury introduced flatly along it; when it has penetrated about one inch and a quarter, the edge must be

* "If the surgeon is determined to excise internal piles, the only safe way of doing so is as follows:—When the tumour is protruded, the base of it should be transfixed by a long needle, which will prevent it returning into the anus. Then it may be cut off; and the cut surface, being exposed to the air, will not bleed so profusely; or, if it does, it is easy to apply cold astringents or ligatures."—Druitt's *Surg. Vade Mecum*, p. 442.

directed towards this opening; and, in withdrawing the instrument, the skin, the sphincter, and the surrounding cellular tissue, are divided to the depth of half an inch.

The most frequent accident after excision is a great and fearful hemorrhage. There are different proceedings for repressing it.

Boyer has recourse to plugging, and only uses the hot iron as a last resource. Dupuytren, however, used it in every case. M. Marx has demanded, whether it would not be more prudent to apply the hot iron as complement of the excision, and without waiting for the appearance of the hemorrhage; a bold question, which Dupuytren seemed half inclined to answer in the affirmative.

The following is Dupuytren's plan. He only placed a small *mèche* in the anus, but left an intelligent aid near the patient. As soon as hemorrhage showed itself, he emptied the intestine of the blood, causing the patient to make efforts of expulsion, and immediately administered a cold lavement. These efforts of expulsion always bring the wound to the outside; and, by means of a special cautery, called *cautère en haricot*, or simply with a reed-shaped cautery, he cauterized the spot from which the blood spouted. This means always sufficed to arrest the hemorrhage, and was never followed by dangerous results (Dupuytren).

Cauterization.—Proceeding of M. Begin.*—M. Begin, considering that excision almost always renders the use of the hot iron necessary, thinks it better to adopt simple cauterization. He makes a plug of lint, which he ties with brass wire to resist the heat. The plug is introduced into the rectum, and the patient is then told to strain as if

* M. Amussat has lately given up ligature for cauterization, which he performs with the "Pate de Vienne" (p. 13), applied by means of a forceps, *porte caustique*. This instrument is similar to the ordinary and dressing forceps; but the end of one of its blades is longer than that of the other, and is bent like a hook, to prevent the hemorrhoid from slipping when seized. The inside of each blade, and also of the hooked extremity, is hollowed out to receive a portion of the caustic. This instrument may easily be made with an ordinary dissecting forceps, by cutting off the extremity of one blade, bending the other, and making a groove on its inner surface. We extract the following from the *Medical Times*, August 16, 1845.—"An enema having been administered, in order to empty the rectum, and the patient having strained, as if to stool, the two hemorrhoids became very apparent. They were about the size of a large nut, but somewhat flatter, and were placed on each side of the gut, not very far from the anal orifice, and presented two corresponding external tumours. The patient was then placed on the right side, and Dr. Amussat seized with the forceps *porte caustique*, the left hemorrhoid, which was the largest and the most painful; after a minute and a half, without letting it go, he opened it throughout its whole extent, evacuated the blood contained in its interior, and cauterized it with the solidified caustic; the latter part of the operation lasted only half a minute. Two injections were next made, in order to remove any particle of the caustic which might have remained, and which might cauterize the surrounding parts; and the patient was placed in a hip-bath, previously prepared, in which he remained several hours, without experiencing any violent pain. The night was passed favourably; no fever; and the next morning the pain was not very intense; the cauterized hemorrhoid was flattened, blackish, similar to an eschar, and the two edges of the incision were visible. Very little food, and an astringent tisane, were prescribed, in order to prevent any stools taking place, as they might cause the hemorrhoid to separate prematurely, and be followed by hemorrhage. For six days this treatment—frequent hip-baths, injections, cataplasms on the anus, and a little broth only—was strictly adhered to; when, on the seventh day, the hemorrhoid separated without producing the least pain, after a very small stool." Dr. Houston recommended concentrated nitric acid, applied by means of a small stick of wood.

to go to stool, whilst the wire is at the same time cautiously pulled. The tumours, or hemorrhoids, come out, and a cautery is applied pretty strongly on them, or two if necessary; and when the eschar seems sufficient the plug is removed. According to M. Bégin the pain is not severe. After the fall of the eschar, the wound cleans, and soon becomes covered with a healthy cicatrix. This mode of treatment has already been several times successfully applied.

(4.) *Venereal Excrescences.*

Single or numerous, in masses, or pediculated, in fact, varying much in size or shape; they may be treated, according to the case, by light or active caustics, by ligature, or by excision. Excision is preferable when they are pediculated or voluminous. Dupuytren seized them with solid forceps, and removed them with scissors; the proceeding is the same as that for external hemorrhoids, but there is not the same danger; the venereal excrescences only affect the cutaneous tissue, and scarcely ever cause any hemorrhage.

(5.) *Polypi of the Rectum.*

Anatomy.—These polypi are generally soft, varicose, spongy, or fungous; usually rounded or pyriform, sometimes like mushrooms, often formed as it were by the union of several lobes; adhering to the mucous membrane by a large base, or by a pedicle of greater or less length and thickness. Their volume varies from that of a pea to that of a hen's egg. They occupy in general the part of the rectum next the anus, but sometimes they are so far up that the finger will not reach them. Ligature, caustic, and excision have been advised.

1. *Ligature.*—A liquid is injected into the rectum, and the patient then makes violent efforts to expel it, and at the same time the polypus. As soon as it appears on the outside, make the patient lie on his side, seize the polypus with a forceps, and draw it out so as to show its pedicle, round which place a ligature well tightened; then cut off the tumour below the thread, so far from it, however, as not to allow of its slipping. After the excision the pedicle re-enters with the ligature on it; it is detached in a few days. It is recommended to comprise in the ligature a portion of the skin or mucous membrane on which the polypus is implanted, to prevent its growing again.

In a case where the polypus, as large as an egg, had its root six inches above the anus, Desault tied it by means of instruments for tying polypi of the uterus, without excising. The patient was cured.

2. *Caustics.*—Employed successfully by Loeffer on a polypus, ligature of which caused intolerable pain. They are generally rejected.

3. *Excision.*—It is performed as for hemorrhoidal tumours. Dupuytren caused the polypus to come out by efforts of expulsion, seized it with a polypus forceps, and removed it with scissors. You might also, if the pedicle is too remote to descend to the anus, direct the scissors to it along your index-finger.

Appreciation.—Excision is the most speedy and simple; but it often causes an hemorrhage that must be stopped by plugging or cauterization. It seems preferable, then, only when the volume and nature of

the polypus leave little fear of this; or, again, when ligature causes intolerable pain.

(6.) *Prolapsus of the Rectum.*

Under this name are described two very different lesions; first, prolapsus of the mucous membrane of the rectum only, forming a projection of half an inch or more outside the anus, and renewing itself every time the patient remains a long time standing, or when he goes to stool; and, secondly, prolapsus of the rectum itself, accompanied by the peritoneum. I lately demonstrated by dissection a complete prolapsus of the rectum, complicated with complete prolapsus of the uterus and vagina; the peritoneum had followed each, and the two tumours were only separated by the perineum, which was lined by peritoneum, at a distance of half an inch from the skin. In the first place, you must endeavour to reduce the tumour, which is done in the following manner.

REDUCTION.—The patient being laid on his back, or, according to some surgeons, on his belly, with his pelvis raised on pillows, so that his anus may be the most elevated part of his body, his thighs strongly flexed, and all the muscles relaxed, the tumour must be washed with warm water, wrapped up in soft wetted linen, and a compress placed on the centre of its external extremity. When it is thus covered on all sides, gentle pressure must be made on its end and sides with your left hand, to diminish its volume, whilst with your right index-finger you gently push it by degrees towards the interior. You must recollect that here, as in eversion of the intestine in artificial anus, the part that comes out last, which is the one to be first returned, is the farthest from the anus, and is the part where the intestinal orifice shows itself. Often it suffices to introduce your finger into this orifice, to push it back, and reduce the tumour. At other times, you succeed better by pressing on the centre of the mass with several fingers together as a cone, as if you wished to enter the anus, and pushing before you the compress with which the tumour is covered. If it is too swollen, compression, by means of a roller, and astringent lotions, assist in diminishing its volume. In case of strangulation, you would always have the resource of dilatation of the anus by incision.

As any one part re-enters, you must mind and support it before attending to another. When the whole is put back, you must use to sustain it a large *mèche*, or a plug of lint, a globular, or oval-shaped bit of wood, ivory, or gum-elastic, a bit of sponge attached to a silver sound (Callisen), the whole maintained by a T bandage. With women, a pessary in the vagina, astringent injections, &c.

As to the curative means, they vary according to the prolapsus. Thus, in the two cases, you may always have recourse to excision of the folds of the anus or sphincter, and cauterization of the anus recommended by Severin, and lately renewed by Benjamin Philip; but excision of the tumour is never suitable for total prolapsus of the intestine.

I. EXCISION OF THE FOLDS OF THE ANUS.—First performed by Hey, but made into a general method by Dupuytren. It is founded on the

following anatomical facts. The anus is surrounded, in the normal condition, by projecting cutaneous folds converging towards the centre, and more numerous the tighter the anus is. When the anus is habitually and unusually dilated, these folds are loosened and effaced; the cutaneous and subjacent muscular tissue has lost its spring and elasticity. By removing some of these folds, you naturally diminish the circumference of this opening.

Proceeding of Dupuytren.—The patient is laid on his belly, the upper part of his body and his head in a sloping position; his pelvis, on the contrary, much elevated with pillows. Put aside his thighs and buttocks, to show the tumour. Then with a forceps, armed with large teeth, to cause less pain, seize successively on the right and left and even in front and behind, two, three, four, five, or six folds of the anus, sometimes effaced, or more or less projecting; and, with scissors bent on the flat side, remove each fold as it is raised. This excision should be prolonged to the anus, or even beyond it, so that the constriction may be effected in as great an extent as possible. In ordinary cases some lines suffice; but if the relaxation is considerable, you may go as far as half an inch.

I use for this operation dissecting forceps terminated by two prongs (this forceps is also useful in many cases, and should be in every surgeon's instrument case). The tumour being forced out, I excise some folds of the mucous membrane immediately above the sphincter, and in this way I have no suppuration externally.

This operation causes no hemorrhage, at least if you have not penetrated very far up; no dressing is necessary. But it is well for the patients to be so prepared, that there may be no need for them to go to stool for a few days after it. The cicatrix forms, and the tightened anus no longer affords a passage for the mucous membrane.

Dupuytren did not use any dressing; and reunion of the little wounds took place by the first intention. Velpeau prefers favouring suppuration by the introduction of a little *mèche*, to procure the formation of the tissue of the cicatrix.

II. EXCISION OF THE SPHINCTER ANI.—Proposed and practiced with success by Robert. This operation consists in removing by means of scissors or the bistoury a portion of the relaxed sphincter, and immediately reuniting the bleeding surfaces by the quilled suture.

III. CAUTERIZATION OF THE ANUS.—The patient being placed as usual, and the anus made prominent externally as much as possible, an iron, heated to whiteness, is applied on divers points of its circumference, as many rays being made as necessary, care being taken to penetrate beyond the skin. For the number of rays, you adopt the same principle as for excision of the anal folds. The result is also to give more tightness to the skin by the formation of inodular tissue.

IV. EXCISION OF THE TUMOUR.—It has been tried successfully by Sabatier. He raised, with a forceps or hook, the most prominent part of the tumour formed by the rectum, and cut it off with curved scissors. Heustis draws it out with his left finger and thumb, and removes it with a bistoury; the rest of the mucous membrane is then

pushed back. Ricord commences by traversing the tumour at its base with two loops of thread, by which to retain it outside; and makes, with the convex bistoury, a circular section by which he removes the whole tumour; but he takes care to tie the arteries as he divides them, and not to continue the section until he has stopped the blood.

Appreciation.—The excision of Dupuytren is more simple and less frightful than cauterization; but, on the other hand, when the prolapsus is complicated with hemorrhoids, hemorrhage may follow, and cauterization should perhaps be preferred. Moreover, excision of the folds and cauterization are suitable only when the protruded parts are healthy; but when there is stricture of the anus, strangulation, or induration of the protruded parts, the tumour should be excised. You must be quite sure in your diagnosis, and not confound prolapsus of the entire rectum with prolapsus of the mucous membrane only. Even in the latter case, Dupuytren abuses excision as likely to cause hemorrhage and abundant suppuration. These dangers do not seem to be demonstrated by experience; and cure was obtained in six days in the case cited by Heustis.

(7.) *Excision of the Rectum.*

Cancer of the rectum was thought incurable, until Lisfranc showed that a considerable portion of it may be removed without danger. He set out with the idea that the cancers, supposed to be deep, generally only implicated the mucous membrane; then, emboldened by experience, and the anatomical facts, he attacked even those that occupied the entire thickness of the parietes of the intestine. The only two conditions required are:—1. That the index-finger can pass beyond the limits of the disease.—2. That the surrounding cellular tissue be healthy, in order that the intestine, free from morbid adherences, may be sufficiently brought down. Experience has not yet shown whether the operation may be performed with any chance of success, when these two conditions are wanting.

Surgical Anatomy.—The peritoneum stops about two inches from the termination of the rectum in woman, and from two to three inches in man. The disposition of the cellular tissue that surrounds this intestine, and the curves its inferior portion offers, permit (after the anus has been detached from the integuments by an oval incision) the intestine to be much drawn out, and to project externally, and thus facilitate the application of instruments. Moreover the tractions necessary for effecting this projection scarcely cause the peritoneum to descend one line. Behind, the anus is one inch and a half from the point of the coccyx; and the rectum, surrounded by cellular tissue, is in contact only with the sacrum: in front in the male, from the perineum to the prostate, it is at a considerable distance from the urethra, which passes away from it at an angle, with an inferior sinus of 21° ; so that the bistoury may, without danger, traverse the adipose and aponeurotic tissues that separate them: above, in front of the prostate, the urethra is in contact with the rectum, in an extent of about a quarter of an inch only; but this union, as well as that of the rectum with

the bladder, is effected by a fine elastic cellular tissue, which the finger itself can dissect; you may then, after having incised round the rectum, and dissected to it, slightly drawn out, remove one inch and a quarter of its entire circumference, without running any risk of wounding the urethra.

In the female the interval between the anus and vulva is usually about one inch; by the effect of accouchement it may be reduced to one-third of an inch; but by means of an oval incision, and slight tractions, you may still cause to project outside, and excise, nearly two inches of its lateral and posterior surfaces, and one inch of its anterior. The latter is less elongated than the other, on account of intimate adherences formed by muscular and aponeurotic fibres that unite the vagina to the rectum, immediately above the sub-cutaneous cellular tissue, and to the extent of a quarter of an inch. But these adherences once dissected, the finger alone suffices to separate the rectum from the vagina as far as the insertion of the peritoneum. The only important vessels are the inferior hemorrhoidal, the transverse perineal, the middle hemorrhoidal, the superficial branch of the internal pudic, and the terminating branches of the superior hemorrhoidal arteries; but you may act on them by torsion, ligature, or compression. Lastly, after the removal of the inferior sphincter, the circular fibres of the rectum suffice to act as a substitute for a superior sphincter above the incision.

Operation.—Lisfranc.—The patient being placed, as we shall describe for lateral lithotomy, the surgeon makes, one inch from the anus, two semilunar incisions, which divide the parts to the superficial layers of the cellular tissue, uniting behind and in front of the rectum; he then dissects, directing the edge of the bistoury perpendicularly on the intestine, which he isolates from all the other parts. The index-finger, half flexed, is introduced into its cavity, and draws it down, making it project considerably; which causes the mucous membrane, the only, or almost the only, part diseased, to be much prolapsed. Then it is very easy with the scissors curved on their flat side, or the bistoury, to resect a great extent of it. Even when the cancer occupies the entire thickness of the intestine, provided it does not extend upwards more than one inch above the anus, you can evert the rectum on itself, and expose all the diseased parts; you then incise the everted portion of intestine parallelly to the axis of the trunk, and cut it off with strong curved scissors.

If the cancer has involved the whole of the intestine, and some layers of the tissue that surround it; after the semilunar incision and the dissection of the inferior part of the rectum in its entire circumference, strong scissors must be introduced on the finger passed into the intestine, and the latter incised parallelly to its axis, in its entire thickness, as far as the limits of the disease. This incision should be made in the posterior wall, to be more remote from the vessels and peritoneum. It allows us to unroll the intestine, and show the disease in its whole extent. If too much blood masks the parts, a bit of sponge, dipped in cold water, is put in the wound for two or three minutes; the lower part of the rectum is depressed with hooks. When

you operate on the female, the fingers of an assistant placed in the vagina are very useful; in the male it is well to have a sound in the bladder, which is also confided to an assistant. Then proceed to dissection of the cancer, which is difficult, long, and laborious, especially in the neighbourhood of the vagina and urethra, tying, as much as possible, the vessels as they are divided, and only stopping at the limits of the disease. Lisfranc has in this way removed one, two, and even three inches of the intestine.

If the hemorrhage is not stopped by the ligature of the vessels, or if all could not be tied, a sponge dipped in cold water is first tried. Lisfranc never hastily uses plugging, for fear of causing inflammations; and when he has recourse to it he removes the plug after a few hours, that it may not irritate much; this method has succeeded with him.

The wound is flatly dressed the three first days, the dressing being renewed three times a day, to allow the pus to escape; then when all fear of inflammation is passed, a large *mèche* of lint is introduced. Lisfranc advises the patient to use one even after the cure, which takes place in two or three months; the rectum retains its functions; a new mucous canal replaces the portion removed; above there forms, at the expense of the muscular fibres of the rectum, and perhaps of the insertion of the levator ani, a fold in the form of a sphincter, which retains the fæcal matters, if they are not liquid.

I should add that relapse is very easy. I have seen it occur in many cases; and in one I operated on myself, before the cicatrization was complete. It is then one of those operations about which the surgeon should be very reserved in his prognosis.

(8.) *Stricture of the Anus and Rectum.*

Strictures of the anus happen especially in consequence of cicatrices succeeding ulcers or operations. They are prevented by placing a large *mèche* in the anus, and are treated in the same way; but you must not hope for a radical cure.

Strictures of the rectum are of various sorts. Sometimes it is a transverse septum, occupying only one side of the rectum; or the entire circumference of the intestine, as a sort of diaphragm, pierced by a narrow, central opening. Sometimes it is a coarctation of all the tunics of the intestine, in the extent of from four lines to an inch, or even more, which reduces its calibre to the diameter of an ordinary quill. The first are situated, generally, one or two inches up, and are explained by the induration of the mucous valves of the rectum; the others higher, and sometimes even out of the reach of instruments.

Cauterization has been tried with success, principally by Amussat; but dilatation and incision are more generally adopted.

I. DILATATION.—Gum-elastic sounds, of a suitable volume, may be used; but *mèches* of lint, introduced by different proceedings, are generally preferred.

Sometimes a simple *porte mèche* suffices; or a small linen bag is first introduced empty, and then filled with lint. Others have advised bladders, filled with air or water, &c.

Proceeding of Costallat.—He uses a bag of linen pushed up with a sound; *mèches* of cotton are then introduced into its interior, until the requisite degree of dilatation is obtained. This is almost the ordinary proceeding, only the sound allows us to carry the bag farther up.

Proceeding of Bermond.—His apparatus is composed of two concentric canulæ, about six inches long. The internal one, smooth, terminated superiorly in a *cul-de-sac*, has a spur on its exterior that fits into a groove, near the free end of the second or outside; the external, about half an inch in diameter, open at both ends, is furnished on the outside with circular grooves, on which a bag may be fitted: they are passed one within the other into the rectum; with long forceps, lint is pushed up into the bag so as to fill it up into a collar, as far as the level of the summit of the tubes, filling it fuller on the side where the greatest dilatation is wished; all must be solidly fixed to the exterior. When the patient has need to go to stool, the internal tube is withdrawn without moving the other; the *cul-de-sac*, formed above by the bag, directs the fæcal matter into the canula, which should be washed with injection; the stool finished, the central canula is put back.

Proceeding of Tanchou.—In a case where the stricture was such, that the sinuosities of the rectum could only be followed with a stylet, Tanchou had made a small tube, one inch long, furnished at its superior extremity with a small collar, on which he placed a *mèche*, and scooped out conically at the inferior extremity to receive a *porte-mèche*, hollow, and five inches long. The probe being introduced he passed on it, as on a director, the tube, and *porte-mèche*, and thus passed the *mèche* beyond the stricture; then withdrew the *porte-mèche* and stylet, leaving in the rectum the small tube by which wind could escape.

II. INCISION.—The patient being laid on his back, with his pelvis elevated, his thighs separated, and flexed as for perineal lithotomy, the surgeon commences by introducing his finger, greased, into the rectum; this introduction must be made briskly, so as not to leave to the sphincter time to contract. It is well to smear the neighbourhood of the anus with cerate. The finger having reached the stricture, pass along its palmar surface a straight, button-pointed bistoury guarded with linen to within half or three-quarters of an inch of the button; put it into the orifice of the stricture, then turn the edge against the constriction, and divide it in withdrawing the blade. For a lateral stricture one incision is enough; for a circular septum, at least two are requisite at the ends of the same diameter; or more, if judged necessary. Then you may put a large *mèche* to beyond the suture, uniting dilatation to incision.

Appreciation.—Dilatation is suitable only for organic and deep strictures; incision for thin and membranous strictures is the most simple and expeditious, and even far surpasses cauterization.

(9.) *Plugging of the Rectum.*

It is advised in all cases of serious hemorrhage, as after most of the operations we have just described.

Proceeding of Boyer.—A large oblong plug, neither too hard nor

too soft, is formed of lint; two large waxed cords are placed across at one end of this plug, and tied over the other end, the four ends of which are united to make only two. First, the patient must be told to make efforts of expulsion to evacuate the blood effused in the rectum; the exterior of the anus and plug must be greased, and the latter pushed up, with a forceps, into the rectum, as far as possible, so as to fix it beyond the open vessels; then the inferior portion of the intestine and the incision must be filled with little strips of lint. This done, separate the two cords of the plug, and place between them a large roll of lint, as hard as possible; this roll must be pushed against the anus with one hand, whilst, with the other, he draws to himself the two cords to make the upper plug descend as far as possible, and ties them over it. The dressing is completed by compresses placed on the roll of lint, and by a T bandage, the lower ends of which should be tightened as much as possible. This apparatus usually presses on the neck of the bladder, so as to hinder the evacuation of the urine; on which account it is prudent to leave a gum-elastic sound in the bladder.

You may also plug the rectum, by introducing into it the centre of a square compress, so as to form a considerable *cul-de-sac*, which should be filled with lint; after which, the corners of the compress are strongly pulled against the buttocks. Levret has employed, successfully, the introduction of a pig's bladder, stuffed with lint. The apparatus should rest *in situ* four or five days: if need of going to stool forces us to remove it before, it should be done with greater circumspection, and replaced immediately afterwards.

The proceeding of removal is very simple, the ends of the cords of the plug are cut or untied, and the plug and lint withdrawn; if the anus is too much tightened, you wait until suppuration has loosened the parts.

Appreciation.—According to Dupuytren, all the apparatus of this kind have the inconvenience of being very troublesome to the patients, and of being almost involuntarily expelled by the efforts provoked by their presence. He prefers the actual cautery in all cases; doubtless, this method is more sure, if the patient will submit to it; but, in the opposite case, the useful resource of plugging must not be forgotten; as to the choice of apparatus, the pig's bladder has, perhaps, the greatest simplicity and security.

(10.) *Foreign Bodies in the Rectum.*

The instruments vary according to the nature and volume of the bodies. The index-finger, alone or with the thumb, a child's or woman's hand, a curette, a spoon, dressing forceps, polypus forceps, lithotomy tenettes, &c., for all substances that can be seized; a gimlet, &c., for bits of wood; cutting pliers to divide metallic rings, and other similar bodies; and, lastly, the three-branched forceps may be found very useful. The happy inspiration of Marchettis is particularly mentioned; he had to extract a pig's tail from the anus of a prostitute; the tail had been pushed in base foremost, so that the bristles, which had been cut short, projected against and stuck fast in the intestine, when

attempts were made to withdraw it : he passed over it a canula, through which he withdrew the tail without difficulty.

In more difficult cases recourse is had to the speculum to dilate the anus ; or to loosening the anus by cutting it with a button-pointed bistoury.

(11.) *Imperforation of the Anus.*

Anatomy.—Sometimes in new-born infants the rectum terminates in a *cul-de-sac* ; this takes place in three ways.—1. The anus is formed of a thin membrane, or by a layer of tissue not more than a line or two thick.—2. The anus is open, but a thin septum exists a little way up.—3. Whether the anus exists or not, the *cul-de-sac* of the rectum is separated from it by so great a thickness of the parts, that it is impossible to recognize the point at which it may be found. The two first may belong to simple obliteration ; the third is a veritable congenital absence of the rectum. We must add another anomaly, in which the anus opens into the vagina.

I. SIMPLE OBLITERATION OF THE ANUS.—When a simple membrane closes the anus, and fluctuation, a projection, or a bluish spot indicates clearly the position of the rectum, it suffices to plunge the point of a bistoury straight into the presumed centre of the intestine ; then with the same, or a probe-pointed bistoury, to cut the membrane from within outwards, and crucially ; each angle being seized and excised. It is then dressed with a *mèche* of lint, to prevent constriction.

If the septum is at some distance from the anus, you would puncture with the trocar, or a bistoury guarded with linen to within a few lines of its extremity, and then incise the membrane crucially ; and, excision not being possible, you would use dilatation.

II. OPENING OF THE RECTUM INTO THE VAGINA.—Martin proposed to divide the perineum and septum to the abnormal anus, and to carry the incision backwards to near the coccyx ; then a canula would be placed in the wound to form a continuation of the rectum, and the anterior surface of the wound would have been healed on the canula. It seemed to me *môre* advantageous to pass a director through the abnormal anus, so as to make the posterior wall of the rectum project into the perineum, to incise on this projection without dividing the *fourchette*, and then to treat the other opening as a recto-vaginal fistula. Whence we have two very distinct methods ; one that divides, and one that preserves, the perineum and septum. These two methods have been applied by Dieffenbach and Amussat, with very ingenious modifications, that should insure their success.

Proceeding of Dieffenbach.—A child three months old, that had been born with its rectum open at the posterior wall of the vagina, without trace of any anus on the exterior, was cured by Dieffenbach by two operations performed at separate times.

He first endeavoured to replace the orifice of the rectum in its natural position. For this purpose a strongly curved director was introduced by the vaginal anus, and a pointed scalpel passed along its groove, dividing the perineum from the vulva towards the coccyx, care being taken not to open the rectum. The cellular tissue surrounding the

extremity of this intestine was dissected ; and when exposed, it was isolated from the vagina in its inferior semicircumference ; and the flap that resulted having been divided in a small extent, the two halves of this flap were fixed by two points of suture to the posterior extremity of the wound of the perineum. When reunion was accomplished, the operator passed to the second operation. He began by finishing the separation of the superior wall of the rectum from the vagina with a bistoury. The intestine, being freed in this way, retracted half an inch backwards ; and, when the inferior and anterior parts of the perineum had been refreshed, it only remained to reunite the edges of the division of the vagina by points of interrupted suture ; and the wound of the perineum, excepting the portion destined for the anus, by two points of twisted suture. The tension not being considerable, there was no need of lateral incisions of the teguments. The operation was perfectly successful. Notwithstanding this success, the second method will always be more sure, and at the same time more rapid, especially by the following method.

Proceeding of Amussat.—In such a case as we have cited above, Amussat decided to make an opening in the coccyx, behind the vaginal anus ; to detach with the finger and knife, the posterior wall of the vagina from the coccyx and sacrum ; go up as far as the *cul-de-sac* of the large intestine, recognize it by the vagina and new passage ; transfix it with hooked forceps, disengage it all round with the finger and knife ; draw it down to the opening in the skin, open it pretty widely, to allow the meconium to escape, and fix suitably by the interrupted suture the opening of the intestine to that of the skin.

The infant being placed on a table as for lithotomy, the surgeon armed with a scalpel with a very short and convex blade, made a transverse incision, about three-quarters of an inch long, behind the vaginal anus ; another incision directed towards the coccyx gave a shape to the opening, by which he introduced his finger to open a passage between the vagina, and sacrum, and coccyx. He cut and tore the cellular tissue that unites these parts (a sound placed in the vaginal anus guards against perforation of the posterior wall of the vagina) and thus penetrated to about two inches, where he met the intestine. From this moment the child instinctively forced down, affording a means of much better recognizing the termination of the rectum, which formed a kind of pouch, than by the vagina.

The operator seized this pouch with a double hook ; by drawing it towards himself he disengaged the intestine from the feeble adherences that surround it, excepting at the side of the vagina, where he was forced to use the bistoury very guardedly. This manœuvre so facilitated the movements of traction, that the intestinal pouch was soon seen at the bottom of the wound, the meconium showing itself on the sides of the hooks. Then the *cul-de-sac* was pierced with a needle furnished with a double thread ; and by this means, and with the hook, the intestine was brought to the level of the skin.

A pretty large opening having been made between the hooks and thread, a great quantity of meconium and gas escaped. The edges of this opening were seized with torsion forceps, and drawn to a level

with the skin, to which they were united by six or eight points of suture, with the intent of preventing the stercoral matter from getting between the mucous membrane and skin. The operation completely succeeded. In new born male infants the opening of the rectum into the urethra or bladder might give the idea of analogous proceedings; and, if these were impossible, the indication would be the same as in case of absence of the inferior portion of the rectum.

III. ABSENCE OF THE INFERIOR PART OF THE RECTUM.—Here we have two resources:—to re-establish the natural anus, by making a passage through the tissues, to supply the portion of rectum that is wanting:—or to make an artificial anus. The formation of an artificial anus will be the subject of a special article. We shall here only describe the re-establishment of a natural anus.

Operation.—Incise the integuments at the spot where the anus should be, approaching rather the coccyx than the anterior part of the perineum, and penetrate deeply in the direction of the rectum, incising the tissues layer by layer; and exploring with your finger before each stroke of the knife, for fear of wounding the vagina or bladder, and to try and recognize by the projection and fluctuation the position of the *cul-de-sac* of the rectum. When you are lucky enough to reach it, puncture it, and then incise in various directions, and afterwards use dilatation. Some prefer the trocar, which is still less sure than the bistoury; as you may see, the latter is used quite in the dark, and at hazard, whence the following method.

Proceeding of M. Martin.—It consists in opening the sigmoid flexure of the colon in the left iliac region by the proceeding of Littre, which will be presently described, taking care to make the incision in the intestine longitudinal, and as short as possible. By this opening conduct, from above downwards, an exploring instrument, a sound, a trocar, a *sonde-à-dard*, &c., to cause the perineum to project opposite the intestinal *cul-de-sac*; or even to traverse the parts that separate it from the perineum, and indicate the route of the bistoury. You would incise in this direction and with these indications; and the operation would then be finished as by the ordinary method, but with more security. You would heal the wound of the belly according to the rules we have laid down.

(12.) *Formation of an Artificial Anus.*

When an infant is born with such an imperforation of the rectum that it is impossible to re-establish the natural anus, or when a patient has a stricture or an obliteration of the same intestine, which opposes the exit of the fæces, the only resource is the creation of an artificial anus. This anus has been made in several regions: in the right lumbar, in the right iliac, and in the sub-umbilical. But the only two methods remaining in practice are those of Littre and Callisen. The first seeks the sigmoid flexure of the colon in the left iliac region; the second attacks the descending colon in the lumbar region on the same side.

I. METHOD OF LITTRE.—The subject lying on his back, make in the left iliac region an incision, commencing on a level with the anterior

superior spine of the ilium, and prolonged almost parallelly to Poupart's ligament to the extent of two or three inches. The integuments, muscles, and fascia transversalis are successively divided with precaution; after which, the peritoneum is opened, and the sigmoid flexure sought. Sometimes it has happened that, immediately after the opening of the perineum, a portion of small intestine has protruded, and its dilatation, with its colour reddened by inflammation, may cause doubt. You recognize the nature of the intestine by the absence of expansions and longitudinal bands, and by the resistance of the mesentery which comes from the right side, whilst the resistance of the iliac meso-colon is felt from the left. Moreover, the colon has a natural tendency to offer itself at the opening. A loop of thread is passed into the meso-colon to fix the intestine to the opening, and the intestine divided longitudinally. It is evacuated; and, at the end of two or three days, when the adhesions have united the intestine to the peritoneum and external wound, the thread may be withdrawn; but care must be taken lest the new anus contract too much.

It has been proposed to unite the wound in the intestine to the external by points of suture, which does not seem indispensable. The intestine retained by the loop of thread has no tendency to re-enter. The other advice which has been given, viz. to perform the operation in two steps, and not to open the intestine until after having caused its adhesion to the external wound, seems not very suitable for an operation for which there is no occasion but in case of pressing and urgent necessity.

METHOD OF CALLISEN.—*Surgical Anatomy.*—The left lumbar colon descends at first in front of the loins, from which it is separated by fat only; then in front of the aponeurosis of the transversalis abdominis and quadratus lumborum, from which it is also separated by a thin layer of fatty tissue; below this aponeurosis it reaches the crest of the ilium, below which it is no longer accessible to our instruments. It is, then, between the loins and the crest of the ilium that we must seek it.

It generally corresponds to the aponeurotic groove between the quadratus lumborum and transversalis, which itself corresponds to the external border of the common mass of the sacro-lumbalis and longissimus dorsi, easily recognized in middling fat subjects. Sometimes it is more internal, and is in great part concealed by the quadratus lumborum. You see that in any case it is on a level with the external edge of the sacro-lumbalis, and more deeply under the external border of the quadratus lumborum, that you are most sure to find it.

The layers to be divided are the skin and fatty subcutaneous tissue; beneath this the latissimus dorsi behind, the obliquus externus in front; more deeply the obliquus internus, and then the transversalis; then the aponeurosis of the transversalis common also to the quadratus lumborum; then the adipose tissue that covers the intestine; and lastly, the intestine itself. But here we have the most important relations.

Almost always, both in the adult and infant, the left colon is deprived of peritoneum in the posterior third of its circumference, and especially when it is distended by gas or fæcal matters. But the space

in which it is thus outside the serous membrane is very variable; and the more care must be taken not to wound this membrane, because it is here very thin, and almost adherent to the aponeurosis of the transversalis. There is no certain indication of this limit. On the contrary, position alone informs us that we have reached the colon instead of some other part of the intestine covered by the parietal peritoneum. For, of the three longitudinal bands of the colon which might have served us as a guide, one is in front, another on the inside, and a third outside; and it is the space between these two last that we have to open behind.

You see then that the operation, to preserve its essential advantage, which is *the integrity of the peritoneum*, demands a great firmness of hand, and great precautions. We at once throw aside the proceeding of Callisen, which, with a simple longitudinal incision, does not permit us sufficiently to see what we are about. Moreover, there is nothing to wound but one of the dorsal nerves and insignificant arteries, that may be cut without inconvenience.

Proceeding of Amussat.—The patient is laid on his belly, slightly inclining to the right side, and his abdomen raised by one or two pillows. A transverse incision is made in the skin, two fingers' breadths above the crest of the ilium, commencing at the external border of the mass common to the sacro-lumbalis and longissimus dorsi, and following it outwards to the extent of four or five fingers' breadths. After the skin and subcutaneous tissues, you reach the latissimus dorsi, which must be cut across in the posterior third of the incision, and the obliquus externus, which is divided in the two anterior thirds; beneath them the obliquus internus, then the transversalis, then the aponeurosis. All these muscular layers should be divided first across, then vertically, to afford a crucial incision, and better expose the intestine. You may even, if necessary, raise the quadratus lumborum, and incise its external edge. Lastly, you reach the adipose tissue that envelopes the colon, and which must be raised cautiously. After which the important point is to make sure of the position of the intestine and its limits.

On the subject you recognize the colon by its greenish colour; this colour also sometimes exists in the living. By percussion you can easily make sure that you are on an intestine of some kind; pressure with the finger causes a sensation of resistance to be felt, whilst outside the intestine, there is, as it were, a want of resistance; nevertheless, to remove any doubt, the intestine should be well uncovered on all sides. If it is contracted, search it behind; sometimes in this case it is completely concealed under the quadratus lumborum, which must be divided. The colon being at length recognized, traverse it above and below, with two needles, in such a way that you may stretch it with two loops of thread, about one inch apart. In the interval between these loops, pierce with a trocar; the issue of gas, or liquid fecal matter, shows that you have entered the intestine; then divide it crucially with a bistoury. When the matters begin to come out, aid their exit by injections of warm water upwards and downwards. When the belly is well emptied, the opening made is drawn forwards by three

torsion forceps, and fixed to the skin by four points of suture; the mucous membrane being reversed outwards, Amussat has remarked that, for this suture, platina acupuncture needles cause much less pain than ordinary suture needles; of course, if the stercoral matters did not show themselves after the incision of the intestine, you would proceed to suture before injecting. You may, to finish, re-unite by points of suture the posterior or the anterior angle of the cutaneous incision, according to its extent.

Amussat has noted that, in drawing out the edges of the intestine with forceps, the entire colon does not follow, but only its posterior wall; so that the anterior wall makes a projection, scarcely marked, opposite the opening, as you may assure yourself with your finger. This is true on the subject, and true also in the living patient, immediately after the operation; but I have seen, some days afterwards, the anterior wall project from the wound, and then form a prominence as large as you can imagine. I once performed this operation, and the belly of my patient was sufficiently bloated to render pillows unnecessary. Neither did I find that it was necessary to divide the muscular layers crucially, as they contract sufficiently to expose the bottom of the wound; and, lastly, the fear of wounding the peritoneum caused me to restrict my incision of the intestine to one from above downwards, with an horizontal incision inwards. The patient was affected with a cancer of the rectum; he died the eighth day, much more from the effects of his cancer than from the consequences of the operation, which were very mild. Excepting some slight adherences on a level with the incision in the intestine, the peritoneum had remained perfectly healthy.

Appreciation.—The method of Callisen, avoiding the opening of the peritoneum, presents one real danger less than that of Littre, and should be adopted, at least as a general method. It has been deemed inconvenient to have the anus at the side, and even a little behind: but the natural anus is itself behind; and, had we to consider nothing but the sexual relations even, I should regard it as a great advantage not to have the artificial anus before.

CHAPTER IX.

OPERATIONS PERFORMED ON THE GENITO-URINARY ORGANS OF THE MALE.

THE genital organs of the male are altogether external to the urinary, on which account we shall begin our description of these operations with such as affected the former. We shall treat successively of those performed on the scrotum, penis, urethra, and bladder; reserving the study of lithotomy and lithotrity for two distinct articles.

SECTION I.—OPERATIONS PERFORMED ON THE SCROTUM.

(1.) *Hydrocele.*

There are several kinds of hydrocele:—1. *Hydrocele by infiltration*, which is nothing but œdema of the scrotum, and needs no special operation. 2. *Encysted hydrocele*, which consists in one or several serous cysts placed generally in the course of the cord, and which requires the same treatment as ordinary cysts. 3. *Vaginal hydrocele*, which is situated in the tunica of the same name, and is found in several different conditions. For instance, sometimes the hydrocele communicates with the peritoneal cavity, because the canal of communication is not obliterated; this is called *congenital hydrocele*. Sometimes the tunica vaginalis, instead of retaining its usual appearance, is thickened, cartilaginous, and even osseous; the testicle also may be diseased, which constitutes an *hydro-sarcocele*: lastly, it may be complicated with varicocele hernia, &c.

We shall first speak of vaginal hydrocele in adults.

In addition to topics and blisters applied on the scrotum to procure re-absorption of the effused fluid, a number of proceedings have been advised, which may be classed into six methods.—

Puncture—incision—excision—cauterization of the sac—the introduction of a seton or other foreign body—and injections.

I. PUNCTURE is performed with a small trocar, with a lancet, or with an acupuncture needle; the trocar is generally preferred. The integuments must be stretched, and the testicle put aside first, then, the patient being seated or lying down, the tumour is grasped in the left hand; its anterior and inferior part being allowed to project between the thumb and index-finger; the superior and posterior parts, where the testicle and cord are situated, being covered by the palm of the hand. The trocar is now plunged into the anterior inferior part from below upwards (Sabatier), or from below upwards, and slightly from before backwards (Boyer); then its handle is taken out, and the canula held in such a way that it shall not escape from the vaginal cavity during the flow of the liquid. If this precaution is neglected, the liquid may be extravasated into the cellular tissue of the scrotum.

Until lately, puncture with the needle was only performed to show the presence of liquid in doubtful cases; but, recently, several English surgeons have employed it with the view of obtaining a radical cure. The needle is plunged into the tumour, and immediately withdrawn; a drop of serous fluid exudes, and whether it is that the liquid becomes extravasated into the scrotum, or that it is re-absorbed, the tumour entirely disappears in a very short time. Unfortunately, relapse is as frequent and speedy as after puncture with the trocar. This proceeding is justly abandoned.

II. INCISION.—The patient being laid on his back, the surgeon standing at his right side, extends the integuments with his left hand, and, with a scalpel, makes an incision from above downwards, in the

long diameter of the tumour. When he has penetrated to the sac, he makes a small opening into it, introduces his finger, and then passing his knife on it, or on a director, enlarges the opening upwards and downwards; some dressing is placed in the bottom of the wound, which is covered with lint, until suppuration is brought on.

The proceeding with a tent, described by Franco, is analogous to incision, and perhaps constitutes an advantageous modification of it. It consists in making an incision into the tumour three or four fingers' breadths long, and keeping it open with a tent of lint, linen, or sponge, more broad than long, and dipped in rose oil. His object is likewise to produce suppuration of the interior of the sac.

M. Jobert has successfully used for hydrocele the subcutaneous incision in the way I have advised it for serous cysts. But up to the present time this method has had but few partisans.

III. EXCISION.—It is performed in four ways.

Proceeding of Douglas.—The patient lying down, as for incision, divide the skin of the scrotum in such a way as to form an oval flap, the great diameter of which extends from above downwards. Having dissected off, and removed, this flap, incise the sac in its whole extent, detach it with the skin, and remove it entirely to the lower part of the spermatic cord. Then bring the edges of the wound together, always introducing some lint to the bottom of the wound to promote suppuration.

Proceeding of Boyer.—He incises the skin in the whole length of the anterior and middle portion of the tumour, separates it from the tunica vaginalis on all sides, and dissects it to near where it is reflected on the testicle. Care must be taken to preserve as much cellular tissue as possible with the skin, in order to avoid gangrene; and not to open the sac before it is completely dissected; when it is accomplished, he incises the tunica vaginalis, and removes it with scissors as near the testicle as possible.

Proceeding of Dupuytren.—He incised the skin as Boyer did, or excised it as Douglas, according as it was necessary, or not, to remove a portion of integument; then he pulled the edges of the incision backwards, so as to cause the vaginal sac and testicle to project by enucleation. He then opened the cyst, and excised it with the scissors.

Proceeding of Kinder Wood.—It is so different from the other three proceedings that it might pass for a new method. After having made a large puncture in the tumour, with an abscess lancet, he introduced through the opening a dissecting forceps, with which he seized and drew out a small portion of the sac, and excised it with a bistoury or scissors. Kinder Wood had three successful cases; but I do not know that any other surgeon has imitated him. I performed his proceeding on several patients; in the first case, the tumour disappeared in a few days, but returned three weeks afterwards; in fact, the hydrocele was complicated with an incipient sarcocoele: in the second case, the liquid escaped into the scrotum through the opening made by the lancet, and rendered it impossible for me to seize the tunica vaginalis. These two attempts do not prove anything either for or against the efficacy of the

proceeding; but other trials I made failed, so that I have at last given it up.

IV. CAUTERIZATION.—A bit of caustic potash, large enough to cause an eschar the size of a shilling, is placed on the anterior inferior part of the tumour. When its action is supposed to have extended as far as the tunica vaginalis, remove what remains of it, and apply on the eschar some ointment. At the end of eight or ten days, the eschar falls off. For five or six weeks, the tunica vaginalis, it is said, exfoliates, and at last adheres to the testicle.

V. SETONS AND FOREIGN BODIES. *Proceeding of Pott*.—He first made a puncture in the usual way, with a trocar, three lines in diameter; through the canula of this trocar he passed into the sac a silver tube four inches long, and through this tube a third instrument, consisting of a stylet five inches and a half long, having a triangular point at one end, and an eye, through which passes in the shape of a seton several threads of silk, at the other. He passed this stylet through the second tube to the upper part of the tunica vaginalis, and pushed it through the scrotum from within outwards, drawing the seton after it. You may recognize in this the first idea of the instruments of M. Belmas for his proceeding for inguinal hernia.

Monro left the canula of the trocar *in situ*: others have substituted a bougie for it. Larrey leaves in the cavity a gum-elastic sound. Reybard pushes through the canula, by means of the stylet, a bit of hemp, also using injections, &c.

VI. INJECTIONS.—Before puncturing, take care to have some very hot and some cold wine ready, so as to be able, by mixing them, to have the liquid of a suitable temperature (so hot that the finger can but just bear it) at the moment of injection. The liquid should be taken up in a silver or pewter syringe capable of holding from ℥viii to ℥xv , and with a tube exactly fitting the orifice of the canula of the trocar.

Having punctured in the usual way, withdraw the trocar, push the canula deeply into the cavity of the tunica vaginalis, and promote the flow of the serum by gradual pressure. When the cavity is quite evacuated, fill your syringe, and adapt it to the canula of the trocar, which you should yourself hold without pushing it in or withdrawing it; and avoid applying its edge against the tunica vaginalis, which would hinder the injection from freely passing. An assistant may hold the syringe, and press on the piston in a continuous manner, gently and gradually. He should not cease pressing until the tumour has nearly regained its former size. If you go beyond this point, you distend the tunica vaginalis too much, or may even rupture it, and cause an infiltration of the liquid into the scrotum.

Sometimes, before the tumour has acquired its former size, your assistant is unable to push down the piston any further. This is caused by the accident before pointed out, viz. that the canula, when too far pushed in, rests against the tunica vaginalis. In this case, you must slightly withdraw the canula. When sufficient fluid has been injected, the assistant withdraws the syringe, and you place your fin-

ger on the orifice of the canula, to prevent its escape. Let it stop in three or four minutes; then evacuate it, and inject a second quantity: two injections generally suffice. It is only when the tumour is very large, and the sensibility blunted, that more are necessary, or that the temperature of the fluid need be raised. The sign, that sufficient irritation has been created, is a sensation of weight and pressure on the testicle felt by the patient, a sharp pain along the course of the spermatic cord, and even in the lumbar region. Whilst the last injection is in, gently compress the tumour, and then suck out with the syringe the last drops of fluid and air.

Three accidents may follow puncture for hydrocele. 1. Sometimes the canula, escaping from the tunica vaginalis, directs the injection into the cellular tissue of the scrotum. This is a serious accident: it arises either from a quick movement of the patient, or from the surgeon neglecting to follow the precepts we have given. Gangrene is to be feared; and the parts should be immediately incised freely, to give exit to the fluid, and relieve the parts engorged with the injection. 2. Sometimes the trocar wounds one of the branches given off to the scrotum, by the internal or external pudic, the spermatic, or epigastric arteries. These branches are generally so small, that their lesion is of no importance. 3. The instrument may penetrate to the testicle; but this seldom causes more than a little pain.

After the operation, the patient must be kept in bed, and the scrotum covered with linen wetted with the wine injection, to favour the consequent inflammation. On the next day, the sac will be found distended with a similar quantity of serum: this distension continues for some time, and then diminishes. Fifteen days are generally required for complete cure. Sometimes the exhalation of serum is so copious, that it is doubtful whether it can be re-absorbed. I saw Dupuytren in doubt in a case of this kind; but it was eventually successful. I have tried with advantage, in such a case, compression with compresses and a bandage. At other times the inflammation is too great, and brings on suppuration and an abscess, which must be opened, or it will open of itself; this only retards the cure. In one case I saw the pus flowing out through the passage made by the trocar, which had become fistulous; in another, serum escaped through the same passage from a part of the sac that had remained free from adhesions. I have also seen cases in which adhesion only took place in about half the tunic, and a small hydrocele persisted in the other half. Lastly, in some cases the operation completely fails.

Sometimes the sign that sufficient irritation has been caused is wanting. In one case I made four injections, the last one being half wine and half brandy, at a temperature of 110° ; and it did not manifest itself. The irritation re-acted on the stomach only, and caused vomiting. The operation succeeded well. Since 1832, Martin of Calcutta employs ioduretted injections, composed of tincture of iodine gtt. xl, water ʒij. This dose suffices for hydroceles that contain from ʒvj to ʒxxx of fluid, and may consequently be considered as sufficient in any case. Velpeau has adopted this injection, which appears to be

more efficacious and less-dangerous than the wine, which it seems likely to replace altogether.*

Appreciation.—Puncture promises but palliative cure; it is, however, the only method to be tried when the hydrocele is so large that the inflammation excited in it by the others would be very dangerous. Cauterization is almost forgotten; incision, excision, and the seton are too painful, without greater chance of success. Injection is doubtless the most simple method, if you except the subcutaneous incision of Jobert, the elastic sound of Larrey, and the hempen tent of Reybard: nevertheless up to the present time, it has generally prevailed—at all events, in simple cases. When you consider the tunica vaginalis to be diseased, you should have recourse to incision, and, if necessary, excision. If the testicle itself is diseased, you can easily castrate.

If injection, aided by compression, does not succeed, I should propose trying to obliterate the sac by traversing it with pins, after the method of Bonnet for hernial sacs: analogy permits us to expect good results from it.

In *congenital hydrocele* the communication between the sac and peritoneum forbids the employment of most of these proceedings:—we then have recourse to the following.

Proceeding of Viguerir.—The patient is laid down, and all the liquid pushed backwards into the abdomen by a kind of taxis; a hernia truss is then applied to obliterate the opening, and hinder the descent of the fluid.

Proceeding of Desault.—It consists in puncture, and injection applied to congenital hernia. He causes all the fluid to descend into the tunica vaginalis, and punctures the scrotum as usual; then, having well assured himself that no intestine has descended through the ring, he makes an assistant compress it well with a pad exactly applied over it, injects two or three times some red wine, and, when the wine has drained out, again withdraws the canula: the hydrocele was cured in the usual way; but, in order to keep back the intestine, and prevent the passage of any wine that might have remained, into the peritoneal cavity, a truss was worn until the cure was complete.

The proceeding of Viguerie is more simple and less dangerous; the advanced age even of the patient should not make us despair of obtaining a prompt obliteration of the ring.

The proceeding of MM. Belmas and Gerdy, and especially that of Bonnet, for the radical cure of hernia are equally applicable here.

* M. Ricord has lately adopted a new method, combining the advantages of the seton with the quilled suture. He now operates for hydrocele as follows:—A long needle, armed with a double silk, is passed through the upper part of the hydrocele and then removed, leaving the loop on one side and the two cut ends of the silk on the other. Another silk is passed in a similar manner across the lower part of the tumour; then a bit of bougie is passed through the loops on the one side, after which the sac is emptied either by a trocart or lancet, and the free ends of silk are tied over similar bits of bougie on the other side, forming a quilled suture. The silk of the ligatures crossing the sac cause sufficient inflammation, and the bits of bougie keep the walls of the sac in apposition, so that adhesion takes place. When sufficient inflammation has been excited, the threads are cut, and the suture is removed. M. Ricord says, he has performed this proceeding in nine cases, with perfect success in all on the first trial.—F. B. Paris, 1843.

(2.) *Oschéochalasia.*

Larrey gave this name to a fatty and lardaceous development of the scrotum, which sometimes causes this organ to weigh thirty, sixty, or one hundred pounds. Castration offers itself as a remedy; but, as the testicle often remains healthy in the middle of this adipose mass, you must try and preserve it.

Proceeding of Delpech.—In a case of this kind, weighing sixty pounds, he preserved as much integument as he could at the root of the tumour, cutting it into flaps, shaped so as to envelop the penis and testicles; afterwards he dissected up these flaps, and turned them back, one on the hypogastrium, the others on the internal surface of the thighs; then he immediately dissected bare the penis, testicles, and cords, preserving only to these organs their immediate tunic; applied the superior flap round the penis, the lateral on the testicles, and, by numerous points of suture, in this way made a cutaneous covering for all these organs.

This proceeding can only be applied when the testicles are sound; but a frequent alteration in these cases is, an extreme elongation of the spermatic cords. Should they then be preserved? Delpech says yes; and assures us that they soon retract, and regain almost their natural length and position.

(3.) *Sarcocele.*

By this name we understand any chronic degeneration of the testicle, whether scirrhus, tubercular, or cancerous, &c. When all medical means have failed, there remain two operations:—ligature of the vessels of the testicle—and amputation of that organ, or castration.

I. LIGATURE OF THE VESSELS OF THE TESTICLE. *Proceeding of Maunoir.*—It consists in laying bare the spermatic cord, by an incision one inch and a half long, in the direction of the cord, and near the inguinal canal; then dissect the cord cautiously so as to isolate the spermatic artery, and the other little arterial branches it may contain: place two ligatures on each of them, and divide them in the interval; then re-unite by the first intention.

In his first attempt M. Maunoir also divided the spermatic nerve; but, severe pain that came on having been attributed to its section, he abstained from it afterwards. This proceeding has been several times successful; but it sometimes fails, on which account M. Maunoir advises complete section of the cord, after ligature of its vessels.

Proceeding of Morgan.—He lays bare the cord, isolates it, dissects out the vas deferens, and cuts from it a bit, an inch or more in length, without troubling himself with the other vessels; then he re-unites by first intention.

By these different methods, atrophy of the testicle is sought to be obtained; perhaps it might be caused better by tying the veins as for varicocele, or by excising a sufficiently long portion of the cord, which would affect all the vessels at once.

II. CASTRATION. *Ordinary Proceeding.*—This operation is per-

formed in three steps:—incision of the skin—dissection of the testicle—section of the cord.

1. The patient lying on his back, the surgeon stands on his right side, and makes a longitudinal incision, descending from half an inch above the inguinal ring to the most depending part of the tumour, along its anterior surface, and middle portion: you may either extend the skin before your knife, or make a fold, and divide it to its base; the first method is generally preferred.

2. This incision being finished, and the vessels tied, if the cellular tissue of the scrotum is free, by drawing the edges of the wound backwards, you can turn out the testicle by enucleation (Dupuytren). If not, you must dissect it out with the bistoury, putting the skin or tumour to either side to suit yourself: use your bistoury freely; but take care not to injure the skin, urethra, or corpora cavernosa, with which the tumour is more or less intimately connected when large, and to avoid also the healthy testicle. Completely isolate the testicle as well as the spermatic cord.

3. An assistant then supporting the tumour, so that the cord may not be stretched, seize the cord between your left thumb and index-finger, and cut it, above where you hold it, with a bistoury or scissors. Immediately tie all the small arteries it contains, relaxing the pressure of your finger to favour the jet of blood; then collect all the ligatures in a bit of linen, and put them in the superior angle of the wound; and, lastly, reunite the wound by first or second intention, according as you have reason to fear the development of purulent sinuses or not. As the cord sometimes escapes from the fingers, and retracts so high as to prevent ligature of its vessels, Lisfranc advises us to seize it between the thumb and index and middle-fingers; this modification would be useful, did it not oblige us to isolate the cord too far. Many surgeons prefer tying the cord itself, as more sure and easy; others object, saying that it causes serious accidents, which, however, have not been sufficiently proved. It seems then to deserve preference.

Proceeding of Aumont.—He makes the incision of the integuments on the posterior part of the scrotum, previously turned up, on the abdomen, performing the rest of the operation in the ordinary way.

Proceeding of Rima.—The patient and operator being situated as for the ordinary method—suppose, for example, the left testicle to be affected—the surgeon raises the spermatic cord with the integuments of the scrotum and left groin between his left thumb and fingers. An assistant, standing on the right hand side of the surgeon, pulls away the healthy testicle with all the sound portion of the scrotum, trying to comprise with the latter the intermediate septum. Another assistant, standing on the left side of the bed, raises the diseased testicle, so that there may be a space between it and the others, and that in this interval the integuments may be slightly on the stretch. The operator then passes in a very sharp knife, a little above the spot where he wishes to cut the cord, and pushes it from one side to the other through the kind of fold formed of the integuments by the fingers of his left hand; then, directing its edge obliquely downwards, he

draws it in this direction under the diseased testicle, so as to detach it entirely from the parts placed beneath it, in the same way as you would perform a flap operation. After having finished this first incision without minding the integuments that cover the diseased testicle, but having the latter raised and held by an assistant, the operator turns the edge of his bistoury vertically from below upwards; and passing it under the cord, divides the latter boldly, with the integuments, in one cut.

The cord almost always escapes from the fingers; but it never retracts very far, unless the cellular tissue that envelops it has been divided. As soon, then, as you put apart the lips of the wound, the cord presents itself, and you may tie the cord altogether, or its arteries separately, as you please. Re-union is accomplished even with more facility than after the ordinary method, since you need not dread to see the exuberant edges of the wound twist on themselves.

Appreciation.—When the tumour is movable and small, the proceeding of Rima may be employed; but it is not much to be preferred to the ordinary, as the dissection, the most difficult step, is then replaced by enucleation. Nevertheless, it has certainly the advantage of removing the integuments at one cut; and its only fault is the escape and retraction of the cord. We might, also, finish our superior incision, leaving the cord untouched; then tie it altogether, and afterwards divide it.

When the tumour is adherent, we must have recourse to the ordinary method, removing a portion of integument in an elliptical incision if it is too extensive. If the vas deferens is indurated, follow it, even into the inguinal canal, dividing the anterior wall of the latter; or even under the peritoneum. Ledran followed the cord, in order to tie it, to the distance of four fingers' breadths above the ring, on a level with the crest of the ilium.

As to the proceeding of Aumont, the author attributes to it the advantage of concealing the cicatrix, and leaving a free passage for the pus: but this is more than balanced by the double inconvenience, of compressing the edges of the wound in the suspensory bandage, and hindering the dissection of the cord as far as the inguinal ring, which is sometimes necessary. It should then be rejected.

(4.) *Varicocele.*

Most authors distinguish *varicocele*, a varicose dilatation of the veins of the scrotum, from *circocele*, a varicose state of the veins of the spermatic cord: but surgeons in the present day generally understand, by *varicocele*, the varicose affection of the cord itself, which is much more common than that of the scrotum. Both affections may be palliated by the habitual use of a suspensory bandage. For the radical cure, recourse was formerly had to ligature of the affected veins, laid bare by an incision; afterwards to excision, followed by ligature. J. L. Petit seems to have performed this operation twice. Since then, ligature of the spermatic artery, and castration itself, have been advised. In the present day, the only methods in use are compression and subcutaneous ligature.

I. COMPRESSION. *Proceeding of M. Breschet.*—He uses small steel forceps with separated branches, forming segments of circles, the teeth of which, covered with linen or a cushion, can be approximated gradually by means of a screw. In the first place, make your patient walk about or get into a warm bath, in order to cause the veins to become prominent. Then let him lie down, grasp the bundle of veins between your fingers, taking care to leave the vas deferens behind. It is easily recognized by its hardness, and the spermatic artery that runs along beside it. Having well isolated the veins, put them between the ends of the forceps, and compress them thus in a fold of the scrotum. Take care to place a first forceps above, near the root of the scrotum, and a second below, about one inch lower than the first, and not to leave any anastomosis outside the two points compressed. Leave the forceps on for forty-eight hours at least: that suffices to transform the parts into a thin, dry, firm, eschar, transparent as parchment, the fall of which is followed by an ulceration that soon heals. There is no loss of blood: the venous cord, compressed between the two forceps, remains filled with concremented blood, and wastes away without inflammation. The coagulum is then absorbed, and no trace of the vessel left.

More than one hundred individuals have been operated on in this way, without the occurrence of any serious accidents. Scarcely a case is mentioned in which feverishness ensued; and there has not been one death. We presume, also, that, the vessels having been destroyed in two opposite points, there is little chance of relapse; but I do not know that this has been verified on subjects examined a long time after the operation.

Numerous modifications of this proceeding have been proposed. The most important is that of Landouzy. It consists in hollowing out the forceps, so that it shall not press on the free border of the fold in the skin, which consequently remains sound, and forms a bridge between the two solutions of continuity.

II. SUBCUTANEOUS LIGATURE. *Proceeding of M. Ricord.*—After having isolated the bundle of veins in the way we have mentioned, M. Ricord passes under them a needle carrying in its eye the two ends of a loop of thread, disengages the needle, and through the same holes in the skin passes another, similarly armed, in the contrary direction over the veins. You have thus two loops, one on the right, the other on the left; one beneath, one above the veins. Then pass the free ends on each side through the loop on the same side; and, by pulling the ends, you cause the loop to enter under the skin, and strangle the varices. To render the compression stronger, you tie each double thread to the ends of a kind of *serre-nœud* in the shape of a horse-shoe.

M. Ratier has simplified the proceeding. He uses only one thread armed with two needles. With the first he passes it from within outwards beneath the veins; with the second, above them, by the same holes and in the same direction; so that, when he pulls the ends, the loop passes entirely under the skin. The two ends are then fixed in a *serre-nœud* like that of Graefe, but small enough to pass into the wound of the skin. A *serre-nœud* of beads would be more simple:

perhaps it would be as well to tighten the ligature by a double knot, which should be made under the skin through the puncture.

You will perceive that these proceedings may be applied to varices of the scrotum, or, indeed, any of the other proceedings used for ordinary varices. Supposing, however, that you obtain the radical cure of these latter, no evil result can occur; but the same is not the case with varices of the cord. Everything leads us to believe that atrophy of the testicle would be the irremediable consequence; and it is well known that a success of this kind, obtained on both sides at once, was the cause of the assassination of Delpech.

SECTION II.—OPERATIONS PERFORMED ON THE PENIS.

(1.) *Imperforation of the Prepuce.*

This is observed sometimes in new-born infants, and recognized by the absence of any urinary evacuation: the urine collected behind the prepuce distends it, and forms a fluctuating projection. It must be opened with a bistoury, and a portion of the prepuce, when it is too long, excised as for phymosis, which is only an incomplete perforation.

(2.) *Section of the Frænum.*

This operation is performed only when the frænum extends as far as the orifice of the urethra, and renders it painful to uncover the glans, or hinders sexual connection, &c.

Operation.—The patient lies on the right edge of his bed, the surgeon stands on his right side, uncovers the glans, and seizes its sides with his left thumb and index-finger, whilst an assistant stretches the frænum, drawing it downwards and slightly backwards. He then plunges a bistoury through this fold from right to left, and, causing it to cut at the same time from behind forwards, divides all the portion of the frænum comprised between its free edge and the place where he entered the bistoury. Care must be taken to graze the glans, so as not to leave any asperities on it after the operation. A bit of lint must be kept between the raw surfaces to prevent their reunion.

Some surgeons prefer the scissors; but the bistoury is better, for the frænum will sometimes slip away from the scissors, or the patient start back, so that you are obliged to cut twice.

(3.) *Phymosis.*

The surgical treatment of phymosis comprises three methods:—incision—excision—and circumcision.

I. INCISION. *Ordinary Proceeding.*—The patient is seated on a chair, with his back applied against a wall, so that he cannot start back; or laid on the right side of his bed. The surgeon pinches up the right side of the opening of the prepuce, and draws it a little forwards; he then insinuates a director between the glans and prepuce in the median line, and on the superior surface, as far as the cul-de-sac of the mucous membrane. An assistant supports the penis, and draws

back the skin, so that the incision shall not go too far. The surgeon himself holds the director in his left hand, and with his right passes a thin, narrow-bladed, sharp-pointed, straight bistoury along its groove. When he reaches the end of the director, he depresses his right hand, and brings out the point of his knife through the skin; and then, sharply drawing it towards himself, he divides the prepuce from before backwards in one cut.

The skin is usually divided farther than the mucous membrane, and the latter is subject to form a small cul-de-sac beyond the incision; it should be divided with a scissors.

Some surgeons advise placing a small ball of wax on the point of a bistoury, and introducing it flat without a director between the glans and prepuce, and then, turning its edge up, finishing the incision as usual. For this the blade must be very narrow, or it will wound the glans or prepuce in its passage. We prefer the ordinary proceeding.

Proceeding of Cloquet.—It only differs from the former in being performed on the inferior part of the prepuce at one side of the frænum. It is described in Celsus.

Proceeding of Cullerier.—He incises the mucous membrane of the prepuce only, beginning at its edge, as if to free the opening.

Proceeding of M. Coster.—This consists in three superficial incisions, on the free edge of the prepuce, and on its dorsal and lateral surfaces.

M. Malapert modified this proceeding by making two incisions at the prepuce and the third at the frænum. These incisions made at equal intervals should be of proportionate extent to the constriction of the orifice—from a quarter to half an inch, but never more.

II. EXCISION. *Ordinary Proceeding.*—After a dorsal incision, made as we have described, the two free edges of the wound are seized, sufficiently put on the stretch, and a triangular bit cut from each with a scissors or bistoury.

Proceeding of Lisfranc.—He used on the prepuce one of the proceedings for excision of the lip. He seized the dorsal edge of the prepuce, drew it away from the glans, and cut a semilunar flap from it with a strong pair of scissors curved on the flat.

III. CIRCUMCISION. *Proceeding of Lisfranc.*—He seizes the prepuce by its free edge with several forceps, holding the skin by its thickness. Assistants draw this skin forwards, whilst the operator grasps it transversely with a ring forceps between the forceps held by his assistants and the end of the glans, and separates in one cut of the scissors all that he wishes to remove, in front of the forceps. This proceeding is pointed out by Gillemeau, who gives two methods of performing it.

Proceeding of M. Ricord.—The operation is divided into three steps. In the first, he draws the prepuce forwards, and traces on it with ink or nitrate of silver the line on which he wishes to make his incision; then he lets go the prepuce. He can now see how far it well retract after the section; and if the line is too far backwards, or too forwards, make another. In the second step, he again brings for-

ward the prepuce, places a dressing forceps immediately behind the line marked, and cuts off all that is beyond it. The third step is for the purpose of removing any remaining excess of the mucous membrane. He seizes the edge of this membrane at the middle of its upper portion, and splits it down to a level with the skin; then he cuts off the ragged edge on each side, and detaches the frænum. This third step is but slightly painful.

Appreciation.—Incision, by the proceedings of Cullerier or Coster, may well be used in cases where an accidental swelling has constricted a prepuce that is otherwise large enough. But in natural phimosis, or when the edge of the prepuce is ulcerated or indurated, more powerful means must be adopted. Incision by the ordinary proceeding leaves two long loose flaps hanging about, more or less tumefied; by that of Cloquet, a long, thick, deformed flap. Excision, usually by the proceeding of Lisfranc, is then indispensable. When all the free edge of the prepuce should be sacrificed, recourse must be had to circumcision, for which the proceeding of Ricord seems the easiest.

Whichever proceeding is preferred, you should bear in mind that the prepuce is not united to the glans by a circular commissure, but that this commissure follows the corona glandis; and that as it is oblique from above downwards, and from before backwards, in this direction the incision should be made.

Whatever proceeding is adopted, you may apply to it a modification proposed by Mr. Hawkins of St. George's Hospital, London. It consists in re-uniting the skin and mucous membrane by means of four or five points of suture. In this way union by the first intention is often obtained, whilst by the old method there was often a nasty ulceration of the wound for a long time. I performed this operation once; but it is so painful, and its success is so uncertain, that I could not advise it as a general method.

(4.) *Paraphymosis.*

Paraphymosis only requires two operations—reduction—and, if that cannot be accomplished by the ordinary means, incision of the stricture.

I. REDUCTION. *First Proceeding.*—When the paraphymosis is of short standing, the penis otherwise healthy, and the strangulation not considerable, the reduction is easy. The patient is laid on the right side of his bed; the surgeon standing on the same side, having greased the gland with oil or white of egg, seizes the penis beyond the circular constriction which forms the strangulation with the index and middle-fingers of both hands at once, whilst with his thumbs he presses on the sides of the glans. At the same time, as he pushes back the glans, he pulls forward the prepuce, as it were, to envelop the thumbs. A bit of fine linen should be placed between the fingers and skin, as it prevents their slipping, softens the prepuce, and renders the operation less painful.

Second Proceeding (Boyer).—When the paraphymosis resists the first proceeding, and is not accompanied by any serious accident, you may hope to cure it by a bandage uniformly and exactly applied on

the penis, prepuce, and glans, pressure being made with the fingers on the infiltrated parts each time the bandage is renewed. The penis should be incessantly supported against the belly. In this way it becomes reduced of its own accord in a few days.

Proceeding of M. Coster.—Instead of compressing the glans with the thumbs from the point to the base (which has the inconvenience of enlarging its base), Coster strongly compresses it in the palm of his hand during five, ten, or even fifteen minutes; then he tries to bring the prepuce over it, compressing it at its base with the ends of the index and ring-fingers, whilst he brings forwards the prepuce with the medius.

When this does not suffice, and the obstacle depends principally on the size of the infiltrated ridge, it is advised to make on this ridge three or four deep scarifications, splitting it transversely, that is to say, in the direction of the length of the penis; then squeeze out the serum, and again attempt reduction.

The next proceeding is as sure, and much more simple.

Proceeding of M. Desruelles.—No matter what the degree of paraphimosis or œdema, so long as the inflammation is not too violent, he commences by compressing and squeezing the infiltrated portion between his fingers, in order to disseminate the serum it contains, and give back its mobility to the cellular tissue. He also passes his finger between the corona glandis and the prepuce, to destroy any incipient adhesions. Then covering the penis with a fine compress, he grasps it in his left hand, in such a way that his thumb and index-finger form at the prepuce a circle that tends to push it forwards; next he seizes the glans between the thumb and fingers of his right hand, compresses and squeezes it forcibly, so as to render it small and wrinkled; and then pushes it vigorously backwards, whilst with his other hand he draws the prepuce forwards. The operation is often long, always tedious and painful, even for the surgeon: the parts may be excoriated, and the glans has even been torn. (Ricord.) But, at all events, the patient is freed from the deformity and strangulation that results from the disease. If the first attempt fails, envelop the parts in a bandage moistened with Goulard-water, and try again the next day.

II. DIVISION OF THE STRANGULATION.—When the strangulation persists, and is accompanied by swelling, with violent inflammation of the glans, you should operate in the following manner:—

The patient lying down, the surgeon seizes the penis with his left hand, the four fingers beneath, the thumb upon the glans; pushes back the prepuce, and beneath it, near the corona, sees a thin extended surface, which forms a circular cord around the penis. Then taking a common, or, better, a concave-bladed bistoury in his right hand, its edge upwards, its back towards the glans, as if to cut from within outwards and from himself, he passes it under this constriction, and divides it by depressing his wrist, and throwing up the point. Then in the same manner he makes two, three, or even four incisions on the constriction in other situations. These incisions put an end to the strangulation and all its symptoms, but do not permit reduction. In

order to perform it, you must procure the disengorgement of the prepuce, either by the proceeding of M. Desruelles alone, or by aiding it with scarifications.

(5.) *Of Culculi situated between the Glans and Prepuce.*

If the orifice of the prepuce is large enough to allow of the introduction of a forceps or curette, and of the escape of the stone, the operation is simple and easy. Even supposing the stone to be very large, you might break it by means of pincers or instruments for lithotomy. But when the orifice of the prepuce is too tight, it must be enlarged by one of the proceedings indicated for phymosis. The proceedings are the same, except that the presence of the calculus permits the surgeon to make his incisions from without inwards.

(6.) *Strangulation of the Penis by Foreign Bodies.*

Cases are frequently seen, where individuals, during mental aberration, place a hair, a thread, a metallic ring, &c., round the penis. The consequent strangulation brings on an extreme degree of swelling, so much so that sometimes the foreign body can hardly be distinguished between the swelling, formed in front and behind it, by the integuments. If this tumefaction is very considerable, diminish it by scarifications. The foreign body being then laid bare, if it can be easily cut, the bistoury or scissors will suffice; but, for metallic rings, you must use the file, saw, pliers, or pincers. In fact, circumstances will guide you; the only rules are to act promptly for fear of gangrene, and yet to be as gentle and soft as possible.

(7.) *Adhesion of the Prepuce to the Glans.*

When the adhesions of the prepuce to the glans are partial, and do not extend to the cul-de-sac of the mucous membrane, it suffices to divide them with the bistoury or scissors, and to interpose a bandage of linen to prevent their re-adhesion. But when there is so complete adhesion as to hinder coitus, and render the operation necessary, you cannot adopt the same method, for re-union would take place despite all your efforts. Dieffenbach tried another proceeding, which consists in removing, by circumcision, a part of the prepuce detached from its adhesions, so as to leave the glans uncovered; but the skin, drawn up by the cicatrization, again covered a third of the organ. He then invented the following proceeding, which is the only one that should be practiced.

Proceeding of Dieffenbach.—If the adhering prepuce is larger than the glans, you commence by amputating the free portion; if, on the contrary, it adheres, commence by detaching its adhesions circularly to a sufficient extent to allow you to draw it over the glans, and circumcise, as in the former proceeding. When it is sound, excise as little as possible, in order to preserve more skin; but, if diseased, preserve only that part which is quite healthy. This first step being finished, pull back the skin of the penis, and the external layer of the prepuce; divide the loose cellular tissue that unites it to the internal layer to one-third of an inch behind the corona glandis, so as to leave

a kind of cuff of skin, quite unattached by its internal surface. Then remove that portion of the prepuce which remains adherent to the glans, splitting it up longitudinally on its dorsal surface, and dissecting off the flaps with fine forceps or scissors; sometimes this internal layer is so indurated, that it is as thick as a sheet of card-board.

Lastly, when the glans is quite uncovered, double in on itself the external layer of the prepuce, so that its bleeding surface may be against itself; its free edge in contact with the cellular tissue of the penis, behind the corona glandis, and the glans enveloped by the epidermic surface with which any adhesion is impossible. The parts are retained in this position by means of thick threads, covered with adhesive plaster passed round the new prepuce, and the penis.

Bathe the parts in cold water until the third or fourth day; then renew the dressing, and commence making hourly injections between the glans and new prepuce, to prevent excoriation of its internal surface. On from the twelfth to the fifteenth day, cicatrization is accomplished, but it requires some days more for the glans to be covered with a pellicle of epidermis. M. Dieffenbach has seen the new prepuce after a time become elongated, and exactly like a natural prepuce; its internal layer had even exchanged its cutaneous appearance for the characteristics of mucous membrane; it was red, and furnished a secretion.

(8.) *Cancer of the Penis.*

Anatomy.—When the cancer attacks the prepuce only, the swelling it determines in its loose and extensible portions pushes the glans far behind, so that you may frequently be led to believe that the body of the organ is affected when the disease is really confined to its envelop; but M. Lisfranc has shown that, even when the cancer is situated on the body of the penis, or at its root, and even on the scrotum, it always begins in the skin, and the fibrous membranes that are beneath it offer a barrier to its progress that it is long in overcoming. Whence this important result, that, in many cases, you may preserve the organ, removing only its integuments.

Proceeding of Lisfranc.—When the cancer is situated at the extremity of the penis, make an incision on its dorsal surface, and parallel to its axes through the whole length of the carcinomatous portion; this incision should be made with a scalpel, held in the fifth position, little by little, and very cautiously. Sponge the wound, and you will see that you have reached the fibrous sheath of the corpora cavernosa. If it is sound, dissect away the cancer, and the penis is saved; if diseased in some points, which usually happens opposite cancerous ulcerations, lay hold of every suspicious part, and dissect it out with scissors. You may even scrape the suspected surfaces of the corpora cavernosa, with the edge of a bistoury held perpendicular to their axes. If, however, the alteration is too considerable, proceed at once to amputation.

In a case in which the cancer affected the root of the penis, and the anterior part of the scrotum, Lisfranc commenced by bounding the disease by suitable incisions; then he dissected it out. The wound

cicatrized of itself; the loose skin of the scrotum, and the neighbouring parts were so drawn up by the inodular tissue, that at some points the cicatrix was linear, and it did not occupy one quarter the loss of substance made.

(9.) *Amputation of the Penis.*

This operation is performed in case of gangrene, cancer of the penis, aneurism of the corpora cavernosa, &c. According to the principle laid down by Boyer, it differs from all the other amputations, inasmuch as here you are advised to remove more skin than flesh, instead of retaining as much skin as possible: in fact, you must cut off more skin than corpora cavernosa; for the latter are so retractile, that, on dividing them even on a level with the skin, the latter would be far too long, and would considerably hinder the dressing and cauterization. You should, however, cut off less skin in proportion as you approach the root of the penis; the retraction of the corpora cavernosa being in proportion to their length: and recollect that it is less serious to cut off too little than too much of the integument, and leave the corpora cavernosa bare.

Proceeding of Boyer.—The apparatus necessary consists in a bistoury with a rather long blade, a gum-elastic sound, and the instruments usually required for tying ligatures and for dressing.

The bladder should contain a little urine, so that the sound may not irritate its walls. The patient being laid on the right edge of his bed, the surgeon standing at the same side, surrounds the portion of penis to be removed with linen, and grasps it in his left hand, drawing the skin towards the glans, whilst an assistant holds it at its root, near the pubis, and extends the skin in the contrary way. Without this precaution, when the penis is amputated near its root, you run the risk of removing a part of the skin of the scrotum, and making the wound much more extensive than it should be. The parts being thus situated, the surgeon divides at one cut the skin, corpora cavernosa, and urethra. But if you are obliged to cut off the penis near its root, and if the skin is not very movable on the corpora cavernosa, instead of dividing them in one cut, it is better to first incise the skin circularly, three or four lines above where you would amputate, and then cut the corpora cavernosa and urethra on a level with the inferior edge of the wound in the integuments. Then seek, and tie successively, the dorsal arteries of the penis, which run along the superior surface of the corpora cavernosa, and those of the corpora cavernosa themselves. When these arteries are tied, the least compression suffices to arrest the blood. Then introduce the gum-elastic sound into the bladder, and fix it in the way we shall describe hereafter; dress the wound, and withdraw the catheter from time to time, to clean or renew it; but its use should be continued until the cicatrization is complete.

When the stump of the penis retains a certain length, the patient can urinate without difficulty; but when amputation has been performed near the pubis, the urine spurts out towards the abdomen, or dribbles down over the scrotum and thighs, and the patients are

obliged to stoop down to urinate. They remedy this inconvenience by the use of a conical-shaped canula of boxwood, ivory, or metal, which is applied by its largest end on the pubis, and serves to direct the jet of urine (A. Paré). It is sometimes difficult, after amputation, to introduce a catheter into the urethra; M. Barthélemy advises placing it before-hand, and cutting it through with the penis; but in thus remedying a slight inconvenience, you risk seeing the internal portion of the sound fall into the bladder.

M. Velpeau recommends a more important modification; viz., to incise the skin first, in order to define better the spot where the corpora cavernosa should be amputated.

I think the principle of Boyer is founded on an incorrect appreciation of anatomical facts. The corpora cavernosa, in the normal condition of the penis, are quite as much retracted as they would be after amputation; then retraction meets with no greater obstacle in the one than in the other case, and the skin makes no difference. Boyer allowed himself to be led away by a deceitful analogy in comparing amputation of the penis with amputation of the limbs. In the latter case, the skin retracts especially, because it is stretched over the whole limb; and its section destroys this tension, and the muscles retract, because they were before kept on the stretch by their insertion into the bones. The corpus cavernosum is fixed only at one end; and, if it seems to retract beyond measure after amputation, it is because it has been excessively pulled and strained. The skin of the penis is also exactly proportioned to its length and necessities; and, when you leave half the penis, it is just and rational to leave half its skin to cover it. I would then substitute for the precept of Boyer the following:—

Cut the skin and corpora cavernosa on the same level. A very simple means of so doing consists in seizing the penis behind the prepuce, and strongly compressing the skin against the corpora cavernosa, so as to draw it all forwards together; an assistant then extends the skin behind, and the operation is performed in one cut, as in the proceeding of Boyer. A small amputating knife is here preferable to the bistoury.

SECTION III.—OPERATIONS PERFORMED ON THE URETHRA AND BLADDER.

(1.) *Imperforation of the Glans.*

Sometimes an incomplete imperforation of the glans is met with in new-born infants, the urine coming away by an almost imperceptible opening; or there may be perfect occlusion. In this case the canal may be felt dilated and filled with urine as far as the stoppage, which is rarely far from the surface of the glans.

When the mouth of the urethra exists, and its edges are only stuck together, they may be separated with the point of a bistoury or lancet. If there is no trace of an opening, you first make a small incision in the direction of the urethra with a bistoury, and then finish the perforation with a needle or trocar. In incomplete imperforation, you

are advised to enlarge the opening, first with a very small stylet, for which are afterwards substituted bougies of increasing size. In all these cases you should be forewarned, that, notwithstanding bougies, the orifice constantly tends to contract; and it is surer to have recourse to the proceeding of M. Amussat.

(2.) *Hypospadias.*

Hypospadias is met with under three forms. In the first the urethra terminates and opens at the root of the frænum, in the spot that corresponds to the fossa navicularis; in the second it opens at the beginning of the scrotum, or in a point intermediate between it and the glans; in the third, the scrotum is divided longitudinally, and represents a kind of vulva, at the bottom of which the urethra is found. This last case is absolutely incurable.

1. In the first case, we are advised to pierce the glans from its summit to the cavity of the urethra with a lancet or trocar, and place a canula in this artificial opening, until the other is obliterated by cauterizing and making it suppurate.

Others advise splitting the glans from the opening at its base to the summit, to a depth that allows of the introduction of a canula, and the reunion of the edges of the wound over it.

It is seldom that individuals affected with this kind of hypospadias require operation: but, when they do, the first proceeding is preferable, especially modified by plunging in the trocar through the urethral orifice to bring it out at the summit of the glans.

2. In the second kind, the urethra is generally entirely obliterated, and no operation is practicable; but, when the urethra opening on the perineum is still permeable in a great extent of the penis, you may imitate the conduct of Marestin in a similar case.

Proceeding of Marestin.—A soldier had a congenital perforation in the perineum, the glans being imperforate. The surgeon, by introducing a probe through the opening, assured himself that it passed on one side into the bladder, and on the other to the extremity of the glans, which was closed by a membrane not thicker than a shilling. The patient was placed as for the operation of lithotomy. The surgeon passed a probe into the urethra, so as to cause the obstructing membrane to project, and made on it an incision like the natural opening of the urethra. He then passed a catheter into the bladder, pared the edges of the perineal opening, and united them by the twisted suture. At the end of six days it had cicatrized. In withdrawing the catheter, which was covered with incrustations, he partly tore it, but it again closed, leaving only a slight constriction at this part of the canal, which in time yielded to the use of bougies.

(3.) *Catheterism.*

Surgical Anatomy.—I have demonstrated that the male urethra, in the normal condition, and during relaxation of the penis, varies in length from five inches and three-fifths to six inches and two-fifths; the mean is about six inches, and I have only twice seen it reach six

inches and two-fifths.* During erection, it may probably attain from eight inches to eight and four-fifths. By raising the penis upwards, without pulling it much, you make a urethra six inches long reach to seven and three-fifths; when pulling it, to nine inches and three-fifths. If you deprive a penis of its integuments, the urethra, without any pulling, reaches to eight inches and four-fifths. When the penis is removed with the urethra and bladder, a very slight traction stretches it to twelve inches and four-fifths, and, by isolating the urethra completely, you might go still further.

An important consequence is learnt from this first fact: viz. that the catheter need not penetrate more than eight inches to enter the bladder, when the penis is raised, but not stretched; and that, when permanent catheters are introduced, seven inches and three-fifths deep, at least one inch projects into the bladder. These measurements were made on the bodies of young and adult subjects; in old men, the hypertrophy of the prostate gland augments the length of the urethra half or two-thirds of an inch, and even more. I should

* "The length of the urethra is from eight to nine inches; it is sometimes less than eight. The extreme dimensions noticed by Whately, in measurements taken from forty-eight subjects, are nine inches six lines, and seven inches six lines."—*Cruveilhier's Anatomy, Lib. of Med.*, vol. vii. p. 610.

"The urethra extends from the neck of the bladder to the extremity of the penis, and is, according to Whately and Ducamp, about nine inches in length. Having seen that it might extend to eleven inches, I could not well understand on what facts M. Malgaigne based his assertion that it was seldom more than six inches long; but measurements that I have since taken warrant me now in stating that its length varies from five to ten inches. This, however, does not at all hinder M. Malgaigne from being correct; and it is thus explained:—When detached from the pelvis the urethra actually attains the length of ten inches; when, on the contrary, it is *in situ*, and in a state of relaxation on the sound, it is only five or six; and when *in situ*, and elongated on the instrument, it is nine and a half. I have assured myself of the correctness of these different measurements, on a great number of subjects in the wards of La Pitié (Hospital), in the dissecting rooms of the Ecole Pratique, and in the operating theatre of La Charité. It is a fact, which the researches of M. Denonvilliers have still more confirmed, and can no longer be doubted, and which is of so much the more importance since in the living patient the sound is necessarily passed whilst the urethra is *in situ*, and in a state of relaxation. It results that, when the instrument has penetrated to the depth of six inches, it must have entered the bladder. I think, however, that to be exact, we should consider the urethra from five to seven inches long during life."—*Vide Traité Complet d'Anatomie Chirurgicale*, par Alf. A. L. M. Velpeau, tom. ii. p. 233.

The following is his statement of the measurements taken on twenty subjects:—

Length of the Urethra.					Length of the Urethra.				
The Penis stretched on the sound containing a stylet.			The Penis abandoned to itself on a sound without a stylet.		The Penis stretched on the sound containing a stylet.			The Penis abandoned to itself on a sound without a stylet.	
Subject.	Inches.	Lines.	Inches.	Lines.	Subject.	Inches.	Lines.	Inches.	Lines.
1	8	9	5	7	11	9	—	6	4
2	8	7	5	7	12	8	5	5	5
3	9	—	6	4	13	8	—	5	3½
4	8	10	5	9	14	7	11	5	8
5	8	9	5	10	15	8	8	5	9
6	8	—	5	3	16	8	3	5	7
7	9	1	6	2	17	9	—	6	5
8	9	—	6	3	18	9	—	6	4
9	9	4	6	1	19	8	—	5	7
10	8	9	5	7	20	8	1	6	11

add also, that on the living subject, the slight tumefaction the penis undergoes when a sound is introduced (which has not been mentioned by any one else) considerably augments the length of the canal.

The urethra is divided into three portions, which are from within outwards: the prostatic, the muscular or membranous, and the spongy or bulbo-cavernous. The prostatic portion varies from seven to eleven lines in length, the muscular or membranous from six to nine lines. But the bulbo-cavernous varies much more, and on it only do the effects of position and stretching of the penis operate.*

We distinguish two parts in this portion: the one ascending, or sub-pubic, commences below and behind, from four to six lines beneath the symphysis and scarcely a line and a half or two lines behind it. It mounts up more or less on this symphysis according to the length of the suspensory ligaments, and terminates at the angle caused by the drooping of the penis. The other, descending or *pénienne*, occupies the penis properly so called, and varies according to the length of the male organ. When the penis is flaccid, these two parts of the canal are bent at an angle of about 45° , which angle is effaced during erection. In a urethra about six inches long, the perineal portion occupied rather less than three inches, the sub-pubic rather less than two inches and two-fifths, and the rest of the canal the remainder.

The two other portions rise obliquely backwards, so that the vesical orifice of the canal is a quarter of an inch above the level of the sub-pubic arch, and one inch and two lines behind the symphysis; and that a straight sound, passed into the bladder of a subject lying on a table, makes an angle of 45° with the axis of the ground and body.

You see, then, that, in a state of flaccidity of the penis, there is at first not only a curve, but even a very acute angle; then a veritable curve formed by the sub-pubic, prostatic, and muscular portions. On raising the penis as in the state of erection, the angle disappears; but the sub-pubic curve persists as strong as before. The urethra is then far from being straight; but it may become so.

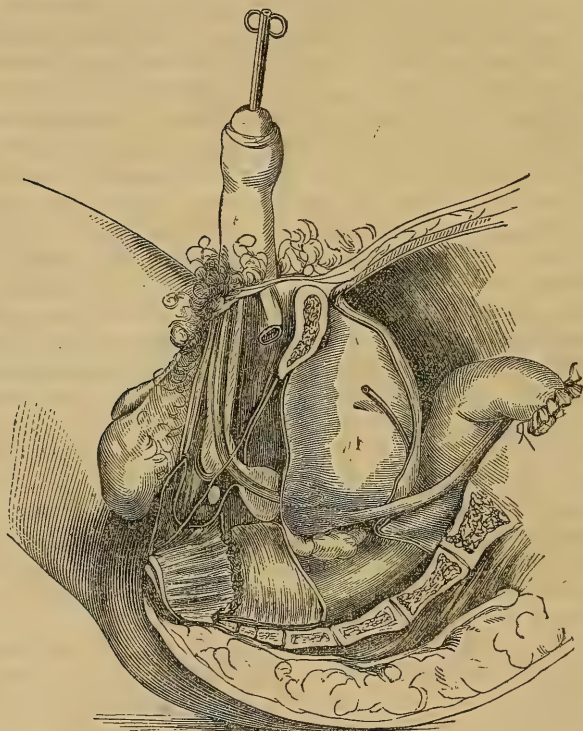
In fact, its parietes are soft and extensible, and it may acquire by dilatation more than four lines and a half in diameter. You see then that a solid instrument, depressing its inferior wall on a level with the root of the penis, and raising the superior under the symphysis pubis, diminishes and even destroys the angle and curve at the same time; but the suspensory ligament of the penis, which attaches it to the symphysis and linea alba, must be relaxed to permit the root of the penis to be thus depressed; and when the penis is attached higher up than usual, or when the symphysis descends lower, the straightening of the urethra is more difficult. It is so, also, when the prostate has acquired a morbid development, that causes the vesical orifice of the urethra to mount above its ordinary level.

* The prostatic portion is from twelve to fifteen lines in length. The pars spongiosa is from six to seven inches.—*Quain's Anat.*, p. 876.

The membranous portion. Its upper concave surface is about an inch long; its lower surface is from four to six lines. This difference in length is caused by the bulb projecting backwards upon the lower surface of the membranous portion of the urethra.—*Cruveilhier*, p. 612.

The length and direction of the urethra being thus determined, it remains to study its interior, and at the same time its texture. The spongy portion surrounded by the bulb is the most dilatable; but its dilatation, hindered above by the corpora cavernosa which lodge it, is accomplished almost entirely at the expense of the inferior wall. It is more considerable at the origin of the bulb, where the spongy substance abounds, almost immediately under the symphysis. The canal

Fig. 22.



Section of the male pelvis; showing the relations of the pelvic viscera, and the perineal fasciæ.

suddenly narrows at the entrance of the muscular portion; it enlarges again at the prostate; but there its inferior wall is divided longitudinally into two lateral gutters by the projection of the veru-montanum in the middle; and, at the entrance to the bladder, you meet on this same wall a transverse projection formed by the tissue of the prostate, and by some muscular fibres designated the *vesical sphincter*. It is this projection that M. Amussat has named the *pyloric valve*. The superior wall, everywhere smooth and dense, does not present any obstacle. You see, then, that on applying the beak of the sound against the inferior wall, you meet two mechanical stoppages or impediments, which may be seen in the dead subject. There are others also which only exist in the living, and which are caused by the spas-

modic contraction of different portions furnished with muscular fibres. Such is the urethra of the adult. In the child the difficulties are less, the penis is less raised, the symphysis descends less, the prostate is almost level, the spongy tissue is slightly developed, and the inferior wall is so firm, that, up to the age of twelve, or even fifteen, you cannot feel any stoppage in the entire length of the canal.

The reverse is the case with old men. The more loose, spongy tissue allows itself to be depressed more towards the bulb: the prostate has generally increased in volume, and its *pyloric valve* is more prominent. From these facts, it follows that, *cæteris paribus*, it is more easy to sound a child than an adult, an adult than an old man.

Catheterism is performed with metallic catheters, straight or curved, or with gum-elastic catheters. Each of these sounds, but especially those of metal, should be previously warmed, which may be done by rubbing them with a cloth; and oiled in their whole extent.

I. CURVED METALLIC CATHETERS.—We shall neither describe the catheters themselves, nor their degrees of curve, which is of little consequence for a canal that is entirely composed of soft parts. We shall only say that M. Récamier had catheters made with a general and regular curve, representing the arch of a circle of seven inches radius; and that M. Mercier has demonstrated the advantage of using, to recognize certain affections of the prostate, straight sounds, bent sharply at an angle, about one inch from their extremity.

There are two ways of introducing them:—

Ordinary Proceeding, or over the Belly.—The patient should be laid on the left side of his bed, with his legs separated and flexed, and the pelvis on a level with the rest of the trunk; a shallow basin should be placed between his thighs.

The surgeon's place is always on the left hand; he seizes the penis with his left hand, uncovers the orifice of the urethra, and the glans also, if possible; applies the thumb behind the corona glandis on one side of it, and the index and middle finger on the other, so as not to compress the canal; and raises the penis in an almost perpendicular direction. The catheter is seized by its handle, the thumb of the right hand above, the index and middle finger below, the beak of the sound looking downwards and backwards. The surgeon introduces it gently into the urethra, and passes it under the symphysis pubis, the left hand remaining almost immovable; when he touches the symphysis, the beak of the catheter is made to pass beneath it, so as to include, as it were, the pubic arch in the concavity of the catheter; when once you have reached so far, gently raise the handle. In this way the beak of the catheter engages itself in the muscular and prostatic portion; at the moment that it passes the neck of the bladder, push it a little more quickly, and, when you feel it enter the bladder, apply your thumb on the orifice of the catheter to direct the jet of urine as you wish.

In all this manœuvre, you should recollect the direction of the urethra, and keep the beak of the sound applied against its superior wall. Sometimes you push against the symphysis; but this is an obstacle easily surmounted. It happens especially when the abdomen

is very prominent in front, or the sound has an exaggerated curve. You may then turn the penis to one side, and not put it straight again until you have reached to underneath the symphysis.

At this point the most serious impediment presents itself. If you do not exactly follow the curve of the canal, you depress the bulb; the beak of the sound is then engaged in this depression, as in a *cul-de-sac*, without issue; and if you press on, even very slightly, you make a false passage; it is in this spot, in fact, that they are generally met with. You are advised, in order to avoid making them, to withdraw the sound some lines, to sufficiently stretch the penis to avoid any folds of the mucous membrane, and to pass the beak of the sound exactly along the inferior border of the symphysis, and the superior wall of the urethra.

Sometimes the spasmodic contraction of the muscular portion is conjoined with this first obstacle; when you suspect this circumstance, it may be useful to anoint the end of the sound with belladonna ointment.

Analogous causes retain the beak of the sound at the pyloric valve; here also you must follow the upper wall. It has been proposed to guide the sound with the hand placed under the perineum, or the finger introduced into the rectum; these manœuvres have sometimes succeeded, but solely by pure hazard; when you have lost the certainty of the exact spot which the beak of the sound occupies, the best way is to bring it back under the symphysis pubis, as your fixed point. But at any time you recognize, by the direction of the handle, whether the beak is inclined to the right or left; and this indication serves to maintain it on the median line.

I do not cite, as obstacles, the lacunæ of the urethra, the verumontanum, &c.; the only real impediments are those I have pointed out. Almost all authors have recommended a movement celebrated for facilitating the introduction of the catheter; they would have you draw the urethra on the catheter as it passes into it. The least reflection on this manœuvre suffices to demonstrate its inutility.

Second Proceeding. The "*tour de maître*."—The patient sitting, standing, or lying down, the surgeon stands between his legs, or at the right side; the sound, held in the usual way, but its beak looking upwards and backwards, is introduced into the urethra with its concavity turned downwards. You thus pass it to beneath the symphysis; then make it rapidly execute a half turn, from right to left, which brings the handle and concavity upwards; this movement, well executed, and accompanied with very slight pressure, will cause the catheter to pass into the bladder.

I have more than once seen the *tour de maître* succeed where the ordinary proceeding has failed. In seeking to explain this, I find that, in the *tour de maître*, the penis is not at all stretched on the catheter; and, applying this idea to ordinary catheterism with straight or curved sounds, it seems that stretching of the penis sometimes renders the introduction of the catheter difficult, when it would have been easy had the penis been left to itself. The stretching of the penis

is then at least useless, when the sound has reached to beneath the symphysis pubis.*

II. STRAIGHT CATHETERS. *Proceeding of Amussat*.—The patient should be so placed that the abdominal muscles and suspensory ligament of the penis may be relaxed. Seat him then on the edge of the bed, with his thighs flexed on his trunk, and his feet resting on two chairs. The surgeon seated in front of him, takes hold of the penis as usual, and brings it to a position almost perpendicular to the axis of the body. He introduces the catheter, which he holds between his right fore-finger and thumb, directly forwards, whilst he draws the penis towards himself with his left hand. If you exactly follow the upper wall of the canal, you reach the prostate without impediment; to pass over the pyloric valvule, you withdraw the catheter a few lines, and depress its handle, letting go the penis, until the instrument is almost parallel to the axis of the body. The beak of the sound being elevated by this manœuvre, the slightest movement from below upwards passes it on into the bladder.

It seems to me that the inclination of the sound to parallelism with the axis of the body is too strong: at 45° it is sufficient; and, in addition, has the advantage of being always in the direction of the urethra. I do not speak of cases where the hypertrophied prostate forces you to increase this inclination beyond measure.

III. ELASTIC CATHETERS.—When the urethra is perfectly permeable, and accustomed to the passage of catheters, you may introduce gum-elastic catheters without stylets. In the contrary cases, they must contain a solid stylet; those which are too flexible are worth nothing. Curve the sound as you wish beforehand; but take care to have the handle of the stylet always at right angles to the direction of the beak of the catheter, so as to be able to direct it.

Hey advises, when you have reached to beneath the symphysis, to hold the stylet fixed with one hand, whilst you push on the catheter only with the other. When the catheter is introduced, withdraw the stylet, bringing it back towards the abdomen with the right hand, whilst with the other you steady the catheter, or even push it on a little into the bladder.

Appreciation.—You can pass equally well a straight or curved ca-

* "The latest fashion in catheterism is that of introducing the instrument with one hand only; the point is passed into the orifice of the urethra, and then by hooking the penis into a position similar to that when it is held between the fingers, partly by pushing the catheter onwards, and partly by, in a manner, shaking the organ on to the instrument, its point reaches the triangular membrane, when it can be slid along as in the common method."—Ferguson's *Prac. Surgery*, p. 554.

Dr. Maisonneuve proposes the following as the best and easiest method of performing catheterism, even in the most difficult cases:—"Introduce into the urethra a very small gum-elastic bougie, and, when it has reached the bladder, slip over it a catheter open at both ends. The passage of the latter inwards is facilitated by a bit of silk passed through it and then tied to the extremity of the bougie. To cause the catheter to penetrate easily and without pain into the bladder, it is sufficient to push it onwards on the bougie, drawing gently all the time on the silk. This method has succeeded in all the cases in which the author employed it, some of these being very difficult."—*Med. Times*, Jan. 25, 1845.

Dr. Barrington denies the originality of this method, and states that he saw it applied fifteen years ago by Dr. Hutton of Dublin.—*Lancet*, March 15, 1845.

theter, provided you know exactly the anatomy of the urethra. M. Amussat prefers the curved sound, when you cannot put the patient into the position necessary for the straight, as in men enfeebled by age, and adults broken down by disease, who are obliged to remain lying. Then, he says, the position of the surgeon is inconvenient; and the tension of the suspensory ligament prevents your depressing the catheter sufficiently to pass it over the pyloric valve. These two reasons have but little real value; and I have convinced myself on the living and dead subject, that you may introduce the straight catheter even in this position; but it is evident that you could not sufficiently depress it to easily evacuate the urine. The same inconvenience also affects the curved catheter, and recourse should be had to the gum-elastic.

The straight catheter is best suited for evacuating the urine; one with a sharp curve for sounding for urinary calculi. When you use a curved catheter with the first object, and the bladder is paralyzed, the eyes of the catheter are soon above the level of the urine, and its beak must be inclined to the right and left to empty the bladder. But, generally, neither the straight nor curved catheter should be rejected; very often, where one would not pass, the other will easily. The "*tour de maître*" also has, perhaps, been too much given up in our time.

One of the most common accidents of catheterism is the formation of false passages. It has been said that they are almost always made at the bulb or prostate, in front of the obstacles pointed out. M. Amussat estimates that the former are in the proportion of ninety-nine to one. I should say that, according to my experience and dissections, the place of election is in front of the bulb, immediately under the symphysis, where the ascending and descending portions of the urethra join.

When called to a case of this kind, commence by cleaning from the urethra the clot of blood it contains, with injections of warm water, and favour their exit by compressing the urethra from behind forwards with your fingers; then take a silver catheter, of large calibre, and gently introduce it along the upper wall, feeling at each advance it makes whether it meets with any obstacle, or the false passage. When it has entered the bladder, withdraw it a little, and leave it until the next day; for you could not be sure of so soon replacing it by a gum-elastic catheter. The next day you can better make this substitution; but it is an essential rule to allow as short an interval to elapse between the removal of the first, and the introduction of the latter, as possible, so as to leave no time for the sphincters to contract (Amussat).

It remains for us now to point out how to fix the permanent catheter. For this you withdraw it by degrees, until the urine no longer escapes, a sign that its eyes are no longer in the bladder. Then pass it in again, and cut from it as much as the portion that passes beyond the internal orifice of the urethra. Some then fix the catheter to a bandage round the body, which is a bad plan, and allows it to sway about too much; others tie a *mèche* of cotton to the end of the sound, bringing

the two ends of the mèche almost behind the corona glandis; unite these there by a simple knot, that allows of your passing them round the penis, and then join them more solidly by a bow knot on one side of the penis; a second mèche, applied in the same manner, is knotted on the opposite side, and the sound between these four threads does not badly resemble the optic nerve, surrounded by the four recti muscles of the eye.

This proceeding is simple, but makes us dread strangulation of the glans in strong erections. It has been proposed, in order to avoid this inconvenience, to attach the four threads of the sound to a circle of thread or iron, placed at the root of the penis, and fixed by other threads to a suspensory bandage. It is infinitely more simple to attach the threads of the sound to holes made in a common suspensory bandage; but even then it is possible that, during erections, these threads, being too much stretched, would hinder the development of the penis, or cause the sound to come out from the bladder.

You need not much fear these accidents if you leave the threads long enough; but M. Boyer has found a means of avoiding them more surely by using thin tapes of gum-elastic to secure the sound. You will find in the following article a still more ingenious proceeding invented by a patient of Ducamp.

(4.) *Of Strictures of the Urethra.*

Anatomy.—There are two very different kinds of stricture; some called *spasmodic*, caused by the spasmodic contraction of the sphincter urethræ; the others, more numerous, called *organic*.*

M. Amussat recognizes four kinds of the latter. 1. *Bridles*, characterized by small white lines situated transversely, particularly on the inferior side of the urethra, slightly or not at all prominent to the eye, but becoming so when the nail is passed along this side from behind forwards. 2. *Valvular Strictures*, which are nothing more than bridles occupying the entire circumference of the urethra. 3. *Strictures from chronic swelling of the mucous membrane*, with or without induration of the sub-mucous tissue. These affect the urethra in a variable extent of from some lines to one inch at farthest. 4. *Callous strictures* characterized by induration, callosities, or nodes, not only of the mucous membrane, but of the different subjacent tissues also. To these must be joined two much rarer varieties—the vegetations of the canal of the urethra, and cicatrices, which are sometimes transverse, like the bridles, sometimes longitudinal.

Organic strictures exist so rarely beyond the bulb, that M. Amussat declares they are never met with. They affect then particularly the

* The urethra in the male "may be contracted through a thickening and condensation of its texture from chronic inflammation; a condition commonly called *permanent stricture*. Or it may be obstructed through spasm of the muscular fibres which surround the membranous portion, which state is called *spasmodic stricture*; and this, in certain cases, is combined with some degree of acute inflammation, whence the term of *inflammatory stricture*."—Druit, p. 450.

"Three kinds of stricture are described, viz.—the *permanent stricture*, which arises from an alteration in the structure of the part of the urethra; the *mixed*, consisting of a permanent stricture and a spasm; and the *spasmodic*."—Cooper's Surg. Dict., p. 1147.

spongy portion, and may occur at any point in it; but their most usual situation, according to the researches of Shaw, is *in front of the ligament of the bulb* under the symphysis, where I have most frequently found false passages; whilst the spasmodic stricture appears to affect more especially the point of union of the spongy and muscular portions.*

No matter where the organic stricture may be situated, that portion of the urethra which is in front of it is almost always in a healthy condition; that which is behind it is more or less enlarged, according to the degree of obstruction and the greater or less violence of the efforts the patient is obliged to make in passing his water. But, however contracted the urethra may be, it is never completely obliterated; and the apparent obliteration always depends either on an inflammatory swelling, or on the presence of thickened mucus, which is secreted in the stricture, and in fact mechanically plugs it up.

The operations needed by stricture have for their object either their exploration or destruction. We shall in separate articles treat of the accidents caused by them, such as retention of urine, and urinary fistula.

PROCEEDINGS FOR EXPLORATION. *Proceeding of Ducamp.*—You must first recognize the distance of the stricture from the meatus. For this purpose a hollow gum-elastic bougie (No. 6), on which are marked the divisions of a foot (in the present day of the *mètre*†) is introduced into the canal. When it is arrested by the stricture, you can immediately see how far it is from the meatus, and note it down.

This relation being learnt, seek the situation of the orifice of the stricture. For this purpose, the exploring sound of Ducamp is used. It is a gum-elastic sound, No. 8, 9, or 10, open at each end, on which are marked the divisions of the *mètre*. The anterior opening of this sound should be less large by one-half than the other. A bit of floss silk is taken, and several knots made in it; it is then dipped in melted wax, which is afterwards rounded into a little ball or pad. This silk is passed into the sound, through its larger opening, by means of a cord. When it reaches the other opening, the ball formed by the knots covered with wax is stopped, whilst the silk passes on, and forms at the end of the sound a fine and strong pencil of down. This pencil is then dipped in a mixture of equal parts of yellow wax, diachylum, shoemakers' wax, and resin, and a sufficient quantity put on it to equal the diameter of the sound. When this moulding wax is cool, it is kneaded between the fingers, and then rolled on a polished surface. This kind of bougie adjusted to the sound is cut off two or three lines at most from the end of the latter, and rounded like the end of a sound.

* According to Mr. Hunter, the bulbous portion is much the most subject to stricture, —a stricture is sometimes situated on this side of the bulb, *but very seldom beyond it*, that is nearer the bladder. According to Sir Everard Home, strictures occur *most commonly just behind the bulb* of the urethra, the distance from the external orifice being six and a half or seven inches. The situation next in order of frequency is about four and a half inches from the orifice of the glans. In almost all the cases which Sir E. Home met with, there was one stricture about seven inches from the external orifice, whether there were any others or not.—See Cooper's Surg. Dictionary, p. 1149.

† The new measure of length adopted in France; it is the 1-10,000,000th part of the arc of the meridian from the pole to the equator; 3.2808992 feet, or 1.093633 yard.

The sound thus prepared is passed into the urethra; the stricture being reached, the instrument is left in situ for some minutes, in order that the wax may have time to become warm and soft; after which, the sound is pushed on. The wax being now pressed between the sound and stricture, fills all the crevices of the latter, penetrates into its opening, and becomes moulded on the shape it presents. The sound is then cautiously withdrawn, and the shape of the stricture is found at its extremity. According as the stalk of wax is in the centre or at one side, you know where the opening is, and on which side to act in destroying the stricture.

If your impression is to be taken at a depth of six inches or more, a suitable curve must be given to the sound by means of a leaden stylet; or, better still, curved elastic sounds may be used.

The length of the stricture is still to be learnt. Small cylindrical gum-elastic bougies are to be obtained, and covered with moulding wax in the following manner. Some shreds of silk are dipped in this melted wax, and, when well charged with it, are twisted round the bougie, which is then rolled between two polished surfaces. This bougie is introduced into the canal to beyond the stricture; and when withdrawn it presents a groove, the extent of which indicates that of the stricture.

But this bougie does not always easily pass into the stricture, especially when the orifice of the latter is situated at one side. Recourse must then be had to the *conductor*. This is a gum-elastic sound, No. 8, 9, or 10, about seven inches long, open at each end, and also marked with the divisions of the *mètre*. If the orifice of the stricture is in the centre, on introducing the bougie through the conductor, it is naturally directed into this orifice. But, if the orifice is at the side, a conductor must be used that bears laterally a more or less projecting eminence near its anterior opening. If the orifice of the obstruction is below, the eminence of the conductor is placed above, and *vice versa*, so that the orifice of the sound, and, consequently, the bougie, may be always in relation with the orifice of the stricture.

Lastly, perceiving the great importance of exploring the stricture from behind forwards, Ducamp invented a special instrument for this purpose. It consists in a gum-elastic canula, No. 1, terminated anteriorly by a small golden cylinder half an inch long, to the end of which are fitted two movable branches one line and a half in extent, which may be separated from the cylinder by pushing the stylet it contains so as to form an expansion two lines in diameter at its extremity. The cylinder is passed shut beyond the stricture, and then its two movable branches expanded: and, on withdrawing it from behind forwards, it is sure to be stopped by the stricture.

Proceeding of Amussat.—The exploring sound of Amussat is composed of a silver canula, eight or nine inches long, marked with the divisions of the *mètre*, the cavity of which does not pass through its centre, but at one of its sides. It is filled by a stylet terminated by a small bulb, adapted exactly to the end of the canula. This stylet cannot be advanced or withdrawn; it can only be rotated. It will be seen that, on turning the stylet half round, the bulb is displaced; and

as it turns on an axis which is not in its centre, it is no longer in a line with the canula, but forms a lateral projection.

This instrument is introduced closed, as far as the prostatic region. The surgeon then causes the bulb to project on that side of the passage which he wishes to explore; then he withdraws the instrument gently, in such a way that, if there exists the slightest bridle or band, it is hooked up from before backwards by the bulb. Numerous trials on the subject have shown that the instrument is not stopped at all when the canal is healthy.

Appreciation.—Amussat's sound is perfectly suited for discovering "bridles" and incipient strictures generally; but for very narrow constrictions the proceedings of Ducamp seem to us still more certain. Doubtless it is possible, by passing the exploring sound as far as the muscular portion of a healthy urethra, to obtain an impression, due to the natural constriction of this portion, or to a spasmodic stricture; but, on the one hand, this chance of error only exists for that portion of the canal; and, on the other, you need only assure yourself of the length of the stricture by the other means recommended by Ducamp.

There are five different methods of combating stricture:—simple dilatation—forced dilatation—cauterization—scarifications—and incision.

I. SIMPLE DILATATION—is performed by means of bougies, sounds, or special apparatus.

1. *Bougies.*—They are made of different materials; but generally of wax, or gum-elastic. These two kinds of bougies act only in a sort of passive manner, since their calibre remains always the same. An attempt has been made to form some that might be susceptible of dilatation in the canal—such as those of catgut; and, above all, the bougies of gelatine, made by M. Charrière under the direction of M. Félix d'Arcet, the primary material of which is ivory deprived of its calca-reous salts by an acid, after the requisite form has been given to it.

The bougie, previously oiled, is introduced gently and with the greatest caution, especially when we approach the stricture. If it enters the stricture, pass in a sufficient length to reach to the vesical orifice of the urethra, but not beyond it. If, on the contrary, you find that the sound pushes against the stricture, and refuses to advance, it must be withdrawn a little, and again pushed on with a drilling motion, or sometimes giving it a slight curve. The employment of force would only make the bougie bend on itself, or, if it were very solid, pierce the parietes of the canal. You may also favor its introduction by supporting the point of the canal, against which it pushes, with two or three fingers. Lastly, the conductor of Ducamp may be of the greatest service here.

When the bougie is once introduced, it must be fixed. You can have recourse to the proceedings already pointed out for permanent sounds; but a much more ingenious one was invented by one of Ducamp's patients. The apparatus consists in a band of caoutchouc united by its ends to form a ring, and of a condom. The bougie being introduced, it is allowed to project an inch and a half beyond the meatus, to provide in case of erection, and doubled back at this

point to the extent of two-thirds of an inch, so that it forms a right angle in front of the meatus. The bougie thus bent and the penis are then enveloped in the condom, and the ring of caoutchouc passed over all.

When the bougie is introduced for the first time, it is held in the stricture so that it resists any gentle efforts made to withdraw it. But by the next day dilatation has been effected, and it moves easily in the canal. It is then replaced by another slightly larger, and so on. You should especially recollect this important rule: *allow as short an interval as possible to elapse between the withdrawal of one and the introduction of the other sound*, so as not to leave time enough for spasm to show itself.

The employment of gelatine bougies requires an additional precaution. If you use them when dry, they are hard-pointed and uneven, and may tear the urethra; on which account it was advised to half-soften them with moisture, which takes from them the greatest part of their dilatability.

I have conciliated all the requirements of the practice by a very simple means, which consists in softening in water the end only of the sound. It then passes easily; the rest follows without obstacle, and you thus place in the stricture a dry bougie, which by imbibition will acquire a notable dilatation.

2. *Sounds.* When you have rendered the introduction of bougies of a certain calibre practicable, you may replace them by sounds. Sometimes, especially when there are false passages, the treatment should commence with them.

Sounds are introduced as the ordinary catheter; only that the existence of the stricture renders more gentleness and caution necessary. To render their renewal more easy, M. Amussat invented his *conducting sound*. It is a common silver sound, straight or curved, the handle of which may be unfixed; but its stylet, on the contrary, screws on to the entrance of the sound, so as to double its length externally. On this stylet and on the sound, which is a continuation of it, you may pass the largest sounds open at both ends. When these latter are introduced, the conducting sound is withdrawn. If you wish to change the gum-elastic sound, you have only to re-introduce the conducting sound into the interior of the one that occupies the urethra, to withdraw the latter, and pass another, as we have before described.

When the stricture presented an obstacle to the introduction of the sound, Dupuytren had recourse to the following proceeding:—he passed a metallic sound close to the stricture, and, fixing it in the way described, left it in without trying to force it on, so that he merely kept up a pressure on the stricture with the beak of the sound. Under this compression the stricture opens, and it is seldom that the dilatation is not sufficiently accomplished to allow the sound to pass.*

* Mr. Guthrie recommends a bougie to be used in the same manner. He says this plan "has never failed in his hands to clear the urethra, and to effect a passage into the bladder." Mr. Liston seems to prefer metallic to gum-elastic bougies, as there is no possibility of guiding the points of the latter, or ascertaining what direction they take. He also remarks, "The securing of a bougie in the urethra merely in contact with the stricture

Amussat obtains the same end with forced injections, of which we shall speak hereafter.

In the same way the bougie "à ventre" are used; other means have also been proposed: the air dilator of Arnot, modified by Ducamp, who fills them with air and water; the linen bag of M. Costellat, of which we have said a few words in the article on stricture of the rectum; the metallic dilators of M. Desruelles, &c. Ledran successfully employed a seton, passing through the urethra, which he brought out again through an incision (*boutonnière*) in the inferior wall of the urethra. But not one of these means offer so great simplicity and efficacy as the bougies "à ventre," or even simple gum-elastic sounds; we need not then do more than mention them.

II. FORCED DILATATION.—Formed into a general method by M. Mayor; it is founded on the principle that you incur less risk of making false passages with large than with small sounds. Mayor had a series of sounds made of copper, the smallest of which was two lines and a half in diameter, and the largest five lines; and the treatment is not usually complete until the largest has passed through the canal. These sounds are introduced as any others; but Mayor tries to pass through the obstacle in one effort, and he certainly obtained sufficiently astonishing successes to retain his method in practice. But a great number of failures, and rents in the urethra, followed by the most serious accidents, have shown that it is only applicable in certain cases where the stricture is easily overcome, and that it is dangerous to employ it as an exclusive method. We perceive this advantage in the sounds of M. Mayor, that they have only one eye, and that one on the concavity of the sound; in fact, the sounds with two eyes scrape the canal, and the patients soon perceive the difference.

M. Cazenave, reasoning on this fact, had endeavoured to re-introduce the sound of Franco, open at its extremity, but plugged during its introduction, by an expansion that terminates the stylet.

Amussat has still more improved the instrument of Mayor. His sounds, which, in fact, are only wanted as bougies, have neither eye nor canal; and he has had them made of much less calibre than those of Mayor, so as to be able to have recourse to them, even in strictures that refuse to admit the latter.

III. CAUTERIZATION.—The "porte-caustique" of Ducamp is composed of a gum-elastic canula (No. 7, or 8), eight inches long, marked with the divisions of a foot (in the present day of the *mètre*), and terminated by a socket of platinum of the same diameter, and half an inch long. Through this socket a cylinder of platinum, five lines in length, and one in breadth, can be passed or withdrawn by a gum-elastic bougie, on which it is fixed, and which serves as a stylet; this cylinder is deeply hollowed by a groove two lines long, and one quarter of a line broad. The nitrate of silver is placed in this groove in the following manner. First pound it very small, and fill the groove

for days and weeks must appear to any one of common sense or judgment a very futile and unsurgical proceeding; a plan certainly not likely to be often called for, in the practice of a man with hands to act and a head to guide them."—Liston's Op. Surgery, pp. 470 and 473.

with it; then direct under it the flame of a candle by means of a blow-pipe; it soon fuses, and exactly fills the groove. The heat should not be too great, or it will cause the caustic to bubble; it is a very delicate point to graduate the heat in a suitable manner. If, after the fusion, any points of caustic remain too prominent, they are removed with a pumice-stone, or in any other way. The instrument, thus armed, then oiled and enclosed, is passed up to the stricture, the exact distance of which has been previously ascertained. When it meets with a resistance, it is stopped; and on pushing the bougie, that serves for a stylet, the cylinder of platinum is pushed out into the obstacle. A mark on the canula indicates always on which side the groove, charged with caustic, is situated. If then the opening of the stricture is above, a movement of rotation is given to the instrument, so that the groove may be turned downwards, and cauterize on that side; if the opening is below, a contrary movement is given to it. Lastly, when it is in the centre, by a movement of complete rotation, the caustic is applied to its whole circumference; at the end of a minute, the cylinder is pulled back into the canula, and the instrument withdrawn.

The groove in the "porte-caustique" contains nearly two-fifths or three-fifths of a grain of nitrate of silver: when the instrument is left *in situ* one minute, not more than one-third of it is dissolved; and generally the one-tenth of a grain suffices for each application.

Three days are allowed to elapse after the first application, before you try anything else; when this time has passed, a fresh impression is taken to judge of the points that project. Then pass a bougie proportioned to the size of the obstacle; if it passes on into the bladder, you may be sure there is only a constriction. Then make a second application, and three days afterwards take a third impression; if very few projections are left, and a No. 6 bougie can pass easily through the obstacle, the treatment is continued by dilatation. When these two conditions are wanting, a third application is made.

If a second stricture exists, attack it in the same way, as soon as the instruments can pass; and a third also, if it exists. When the stricture was more than six inches deep (the penis being stretched and elevated), Ducamp used a "porte-caustique," whose canula was slightly curved, and in which the stylet could turn without it being necessary to move the canula itself.

Lallemand has modified these two "porte-caustiques;" the principal change consists in the employment of a platinum canula; and for the curved canula you are obliged to have cylinders, one bearing its groove on its convexity, the other on its concavity. But these instruments, like those of Ducamp, have the disadvantage of cauterizing from before backwards, and of acting always blindly; with the following you can cauterize with much more certainty, either from before backwards or from behind forwards.

Proceeding of Heurteloup.—He commences by introducing into the obstacle a hollow bougie, containing a metallic stylet; the bougie is withdrawn, but the stylet is left *in situ*, as it is to conduct the porte-caustique; for this purpose M. Heurteloup caused a small central tube to be made in the platinum cylinder, in the socket that supports it,

and in the stalk of the "porte-caustique," through which tube he passes the conductor.

Proceeding of Amussat.—He also has two "porte-caustiques," one straight, and one curved; the straight is composed, first, of a silver canula, which differs but slightly from the preceding canula, excepting that one-half of its circumference is thicker than the other; secondly, of a silver stylet, grooved, to receive the caustic; but this groove only extends to within half a line of the extremity of the stylet, which is implanted into one side of the circumference of a smooth bulb; the projecting part of which corresponds to the caustic, and is fitted to the thickest side of the canula, so as to form for it a smooth beak when the instrument is closed. You foresee how this instrument (copied from the exploring sound) should act. It is introduced (shut) to beyond the stricture, and, by a movement of rotation of the stylet, the bulb is made to hitch up the obstacle from behind forwards; then the operator withdraws the canula, and thus lays bare the caustic, which is necessarily in contact with the obstacle, and attacks it very certainly. The cauterization terminated, the instrument is not completely closed, for fear of pinching the mucous membrane; but it is rotated to withdraw it from the canal.

The curved "porte-caustique" is constructed on the same plan, only it requires two stylets like that of M. Lallemand; and the projection of the bulb is no longer obtained by rotation, but by pushing it half a line forwards.

IV. SCARIFICATIONS.—This proceeding, up to the present time, has met with fewer partisans than the two preceding. The fault is not in a lack of instruments; Dorner, they say, used a kind of lancet conducted through a sound; M. Despinay had recourse to a straight, very narrow, and probe-pointed bistoury; M. Ashmead invented a bistoury caché, like that of Friar Côme, its sheath being prolonged in a blunt or probe-point, to pass beyond the obstacle, and its blade sharp in the extent of seven or nine lines only, near its extremity.

M. Amussat has already brought forward three scarificators: the first, called the "urétrotome," consists in a conical steel cylinder, six or seven lines long, and armed with longitudinal sharp cutting edges, each one quarter of a line long. A stylet was first passed through the obstacle, and on it the "urétrotome" was directed, cutting from before backwards.

The second, called the "*coupe-bridges*," would perfectly resemble the exploring sound of the same author, were it not that the end of the canula, corresponding to the bulb, was sharp all round.

The bulb, being introduced beyond the obstruction, the canula is pushed forwards, and the bridges or bands between the bulb and circular edge are necessarily divided.

The third is more complicated; it is composed of a canula, which presents, at its anterior extremity, a cleft half an inch long on one side, and a notch half a line deep on the other. The stylet itself bears at its extremity, on one side, half a bulb, which occupies the indicated notch; and, on the other side, a small semi-circular cutting blade, received in the cleft of the canula. The instrument is introduced into

the urethra as far as possible: the stylet is then pushed on, one or two lines, to cause the half bulb to project, and catch up the obstacle from behind forwards. When you have thus assured yourself of the presence of the bridle, or constricting band, turn the instrument half round, to present the cutting blade to it, and cause it to act by pressing on the obstacle; the incision being made, draw back the blade into the canula. The instrument is withdrawn without any danger to the healthy parts of the urethra.

More recently M. Desruelles has patronized a kind of circular rasp, before mentioned by A. Paré, with which he scrapes, tears, and destroys the stricture. We cannot predict a better destiny to this instrument than to any of the other scarificators.

V. EXTERNAL INCISION OR "BOUTONNIERE."*—An old operation, condemned by Desault, and recently renewed in Germany, England, and America.

A sound, or grooved staff, is passed to the obstacle, and fixed by an assistant; the surgeon makes a wide incision on the inferior wall of the urethra, and reaches the guiding staff, which he withdraws slightly; he then seeks the continuation of the canal at the bottom of the wound, whilst the patient endeavours to urinate, and tries to introduce a director or probe into it, on which to conduct the incision beyond the stricture; afterwards, a permanent sound is placed in the urethra, over which the two edges of the incision are united.

Appreciation.—Incision applied to the treatment of stricture is generally a bad operation; for either the stricture may be traversed by a sound or bougie, in which case it is better to try to pass it by the urethra itself; or it is too narrow, and it will be still more difficult, after the incision, to introduce a director into it. In this case, continuing the incision without a director, as some have advised, is an irrational operation, especially as there are other means of remedying retention of urine, the only case in which its employment can be thought of.

Scarifications offer, certainly, a great advantage in dilatation of the canal, but not one of the instruments seems to us sure enough in its action. It appears to us that a scarificator, to obtain its end, should, 1. Act on the entire extent of the obstruction, and not go beyond it. 2. Act by longitudinal incisions. 3. Incise from the base of the stricture to its free edge, to be sure of dividing it entirely.

Cauterization and dilatation remain; for the first, the instruments of Ducamp, especially with the modification of M. Heurteloup, seem to us preferable, when the stricture is very narrow; but when the bulb of M. Amussat can traverse it, the last applications should be made with his "porte-caustique." But dilatation is the ultimatum of all these methods, and as it is as efficacious by itself, in a great number of cases it should be adopted as the general method, the others being reserved for exceptional cases. We must not omit to say, that when the stricture is so tight that it resists the passage of the smallest sounds, a valuable means of favouring its dilatation is afforded by forced injections, repeated for several days (Amussat).

* "Bouttonnière," a button-hole.

Whatever method has been used, it would not be prudent to promise a radical cure. But, to prevent return, the patients should, from time to time, pass a large sound through the canal.

(5.) *Retention of Urine.*

Retention of urine is always caused, either by spasmodic contraction, inflammation of the urethra, or stricture. In the two first cases, careful catheterism usually suffices; and it is principally for the last, and when catheterism is impossible, that recourse is had to special proceedings. These proceedings are—forced injections—forced catheterism—incision—and puncture of the bladder, which will be described separately.

I. FORCED INJECTIONS. *Proceeding of M. Amussat.*—His proceeding is founded on the fact, that the canal of the urethra is never entirely obliterated, and that complete retention is almost always caused by a plug of mucus, which blocks up the stricture, and the largest part of which being behind, it can scarcely be driven forwards by the urine, whilst nothing is easier than to push it back from before.

The patient, being seated on the edge of his bed, with his legs resting on two chairs, the surgeon stands in front of him, and introduces into the urethra, as far as the stricture, a very flexible gum-elastic catheter of small diameter, and open at both ends, like a canula.

He adapts to this catheter a syringe, previously filled with warm water, and carefully emptied of air. Everything being thus prepared, he forcibly compresses the urethra on the catheter, with his left index and middle fingers; whilst, with his right hand, he abruptly compresses the syringe, to squeeze out the fluid it contains. Sometimes the force of one hand is not sufficient; the syringe must then be placed between his knees, to compress it more strongly, and by shocks. The liquid thrown out, in a rapid jet, against the stricture, pushes back the plug of mucus, and almost immediately the patient, on making efforts, can evacuate a few drops, or even a small jet of urine. If the first injection does not suffice, which is often the case with old men, a second must be thrown in, and even several others, if necessary.

After the injections have been repeated for some days, the stricture is sufficiently dilated to allow a bougie to traverse it.

Some have wrongly wished to ascribe the invention of this proceeding to Sæmmering: but they would more justly find the first idea of it in Theodore de Mayern, who passed air into the urethra to overcome strictures. I regard this means as very useful, but it requires a practiced hand. You must remember that the bladder is already excessively distended, and according to the laws of hydraulics, the jet of liquid, however small, exerts an equal pressure on every part of this organ; and, consequently, tends to dilate it still more, in an abrupt manner, and if it is injected with too great violence, may rupture the organ.

II. FORCED CATHETERISM. *Proceeding of Boyer.*—He uses a metallic conical solid sound, of middling size, and slightly curved, whose stylet should exactly fill it. The patient being laid on the left side of

his bed, the surgeon gently passes the sound, previously well oiled, into the urethra, as far as the stricture. When it has reached it, he passes his left index-finger, greased, into the rectum, and pushes the penis from before backwards on the sound, which he holds between the thumb and radial side of his index-finger, semi-flexed; and as the fingers might slip upon the sound, and so lose part of the force obliged to be used to make it advance, a bit of linen should be placed between them and it. Affairs being in this condition, the surgeon pushes the sound in the direction of the urethra, without inclining it to either side, with a force proportioned to the resistance he meets with. The left index-finger, which serves as a conductor for the sound, informs him whether in advancing it retains the direction of the urethra, or is removed from it; and, in the latter case, on which side to carry it to bring it back to this direction. The depth to which the sound has penetrated, its direction, and the facility with which its handle is depressed, lead him to presume that it has entered the bladder. Then he withdraws the stylet, and if the urine flows out, his presumption is converted into certainty. But since the urine begins to flow out as soon as the eye of the sound, nearest its beak, has passed the neck of the bladder, and the instrument then only passes about half an inch beyond this neck, it is well to push it a little forwards, proceeding gradually, in order not to injure the parietes of the bladder.

Sometimes you do not succeed at first, either because the sound has been arrested by the stricture or can only pass a few lines beyond it. In this case wait until the irritation is calmed, and then renew the attempts; provided you do not make false passages, you gain ground little by little. Boyer has seen patients into whose bladders the sound did not enter until the end of a month, and after trials often repeated. You then proceed as when you have placed a first sound in a stricture, that is to say, you leave in the conical sound for two, three or four days, and then substitute for it a gum-elastic sound, a little larger, successively augmenting the caliber of the sounds.

III. INCISION. (*La boutonnière*.)—It is easy enough sometimes, when the collection of urine has dilated the urethra behind the stricture, and shows itself by fluctuation. You then, at least, have a guide for the bistoury, and there is no doubt but it should be preferred to puncture of the bladder; but we cannot approve of it when this condition is wanting, though M. Amussat has sought to re-introduce it.

Proceeding of M. Amussat.—He proposes to open the canal a little behind the bulb, and to introduce, through this opening, a catheter to empty the bladder; the bladder being emptied, he would withdraw this catheter to introduce a second, by the meatus, as far as the part constricted: this done, he would incise the stricture itself, and conduct this sound on into the bladder.

(6.) *Urinary Fistula.*

The means adopted to remedy these fistulæ are classed into four different methods.

I. ORDINARY METHOD.—The first indication is to re-establish the course of the urine through the urethra, by introducing a catheter into

the bladder. The proceedings do not differ from those for simple strictures. But M. Amussat prefers using a straight sound, as being more easy to guide into the bladder without straying into the fistulous passage. This sound is left *in situ*: the fistula generally tends to close up when the urine no longer passes through it, and the callosities even become softened. Sometimes, however, the urine passes between the sound and canal, and again irritates the fistula. This accident is avoided by leaving the sound constantly open, in order that the urine may always have a free issue by it. Lastly, when this means does not succeed, Boyer advises to replace the sound by a large bougie, which the patient withdraws whenever he wishes to urinate. We cannot conceive what advantage the bougie could have over the sound, and the fact cited by Boyer, is rather a support of the following method.

II. METHOD OF DUCAMP.—According to Ducamp, the sound when left in, has the inconvenience of irritating the fistulous wound in its quality of a foreign body, and he likens its action to that of a pea in an issue. He only occupies himself then in destroying the stricture. When the natural passage is re-established, the fistula tends to close of itself. But if it persists, a sound should not be left in, it sufficing to introduce one each time the patient wants to urinate. In support of this method numerous facts may be cited, reported by their authors as cases of spontaneous cure, after the ordinary method had been tried without success.

III. SUTURE.—Though repeatedly attempted, it has more often failed than succeeded. The fistula is first transformed into an elongated fissure by removing the callosities; but, always acting on the integuments rather than on the parietes of the urethra itself, which should be left uninjured as much as possible. Then a permanent gum-elastic bougie is introduced, and the edges of the wound brought together over it by points of twisted suture, which should not be more than three or four lines from each other.

We think that the frequent failure of the suture is owing to the presence of the sound, and that it would be more wise to withdraw it immediately after the suture is made. When the patient wants to pass his water, a middling-sized straight sound should be passed, leaning it more than ever against the superior wall of the urethra.

IV. URETROPLASTY.—When the fistula is accompanied by loss of substance, M. Dieffenbach successfully made incisions at the side of, and parallel to, the wound, which allowed its edges to be brought together without straining.

Sir A. Cooper, and after him Earle and Delpech, have applied the Indian method to these cases, borrowing the flap of integument from the neighbouring parts of the penis and scrotum, from the groin, or even from the internal part of the thigh. Here, again, the failures have exceeded the successes.

The ancient method seems to us more simple; but perhaps it also leaves us more reason to fear consecutive stricture of the urethra. It has been successfully employed by M. Alliot, but with a very ingenious modification. He circumscribed and dissected a small quadrilateral flap, and taking from the other side a portion of skin equal to this

flap, he covered with it the fistulous opening and the loss of substance, so that the principal suture was at a distance from the urine when it passed through the urethra. The operation perfectly succeeded.

But even with these ingenious modifications, the cure of urethral fistula was one of the greatest difficulties in operative surgery. It is the urine which, by its contact, hinders the adhesion of the edges of the fistula or of the flap; and it is an enemy rather to be removed than combated. Dieffenbach first had the idea of incision (*boutonnière*) which would afford a passage to the urine whilst the obliteration of the fistula was operating; but he was afraid of producing by it a new fistula. M. Ségalas has removed this fear, and formally advised the practice; and M. Ricord was the first to put this idea into execution with perfect success. The operative proceeding has been described in the preceding article, only, in case of fistula, a catheter must be introduced through the incision (*boutonnière*), until the fistula is absolutely closed.

Lastly, there are cases in which the urethra is completely obliterated in front of the fistula. Then you have to choose between puncture by the urethra itself, to bring out the trocar at the wound, and incision (*boutonnière*). These cases are, happily, very rare.

(7.) *Of Calculi arrested in the Urethra.*

Calculi are arrested in the prostatic, muscular, or spongy portion.

I. IN THE PROSTATIC PORTION.—Sometimes the calculus completely obstructs the canal; sometimes it allows the sound still to penetrate into the bladder.

In the first case, a grooved catheter is passed down to the obstacle, on which the muscular portion of the urethra is cut. When the incision has arrived near the calculus, it is made to project by means of one or two fingers of the left hand introduced into the rectum. The incision is then enlarged on the stone itself. Care must be taken to divide all the bands that retain it, especially when it is uneven; after which it is drawn out with a curette or pincers.

In the second case, the integuments are first divided as in the operation of lateral lithotomy; then a part of the muscular portion, and the prostatic portion, as far as necessary, are divided on the groove in the catheter. When it is judged, by the finger passed to the bottom of the wound, that the incision is of sufficient extent, the calculus is pushed forwards by means of the fingers passed into the rectum, and extracted as in the preceding case. If its extraction offers any difficulty, an assistant introduces his fingers into the rectum, so that the surgeon may have his two hands free, to terminate the operation.

II. IN THE MUSCULAR PORTION.—The patient is placed as usual; the surgeon passes his left index-finger into the rectum, so as to push the stone towards the perineum, and the assistant, who raises the scrotum, also extends the skin to be incised. An oblique incision is made either on the grooved catheter, or on the calculus itself. Care must be taken to enlarge the incision as much as required, and to leave no band that might hinder the exit of the calculus. He then proceeds to extraction, pushing it with the finger placed in the rectum,

and drawing it outwards at the same time with a curette, polypus forceps, or pincers.

III. IN THE SPONGY PORTION.—The proceedings have been multiplied; but we shall divide them into four classes, according to their degree of efficacy.

1. *Dilatation of the Canal.*—To this first method belong local or general emollient baths, oily injections, then direct dilatation of the canal, either inflating it with air, and afterwards applying suction to the penis, by the proceeding of the Egyptians, or employing catgut, sponge, or simply sounds of large caliber, and ordering the patient to force out his urine at the same time as the sound is withdrawn. These means can only succeed in very easy cases.

2. *Instruments for Extraction.*—Simple dressing forceps were used, or the curved ones, furnished with a spring, to separate the branches in the canal. Marini introduced a metallic wire behind the calculus. Others have advised a kind of curved sound, or rather crochet. The forceps of Hales, or that of Hunter, is more celebrated; it is composed of a shank contained in a silver canula, and terminated at its free extremity by two branches, whose own elasticity tends to make them separate from each other. The instrument is introduced, closed as far as the calculus, then the canula is withdrawn; the two branches set free, separate, and embrace the calculus by the two ends of its diameter. This forceps has been modified in several ways; it has been more curved, so as to be made to penetrate beyond the symphysis; the shank has been split into three branches instead of two. The most important improvement is due to M. Civiale, who has perforated the shank by a central canal, through which passes a stylet; which, when pushed forwards, serves to recognize whether the calculus is well embraced by the forceps, and when drawn back to separate the branches more strongly.

The forceps of Amussat is more simple and strong. It is a canula split at its anterior extremity into four slips, and traversed by a metallic stylet, terminated by a rounded button. When the instrument is closed, the button of this shank forms its extremity; in withdrawing this stylet and button, the slips of the canula are separated from within outwards, as much as the urethra will bear. On withdrawing the stylet a bit more, the button falls into a hollow, made at the root of the slips, which immediately tend to become re-approximated to each other by their own elasticity and spring. This instrument is passed, closed as far as the calculus, then the stylet is withdrawn at the same time as the canula is gently pushed forwards to embrace the calculus; and, with the fingers placed under the penis, it is pushed between the branches or slips, from behind forwards. When it is well seized the button is made to fall into the hollow, to increase the pressure of the branches, and it is withdrawn, the finger always pressing through the integuments on the calculus, from behind forwards.

M. Leroy d'Etiolle has recently invented an instrument, in my opinion, much superior. It is a sort of divided crochet, formed of a long rectilinear shank of steel, and of a small transverse branch about

two lines long. This small branch is raised on the shank, so as to be in a line with it when the instrument is introduced; but when it has reached to behind the stone, a very simple mechanism renders it transverse, and you then act on the calculus, from behind forwards, with great force and security.

3. *Crushing Instruments*.—Albucasis used a simple perforator to break the stone. A. Paré and Franco advised an auger, enclosed in a canula. Fischer, after having made an opening as large as a goose-quill in the stone, introduced in the hole a forceps, the branches of which he then forcibly separated, and in this way reduced the calculus to bits. M. Leroy d'Etiolle proposes to use for this, the forceps of A. Cooper; the branches of which are separated by a shank pushed from before backwards. But up to the present time these instruments have not been made in such a way as to present all desirable guarantees, and it is a branch of surgery to be improved.

In case a bit of gravel should form for itself a cell in one side of the urethra, M. Leroy proposes the following method. After having measured the distance of the calculus from the meatus urinarius, take a canula, large or small, according to the diameter of the part constricted, and presenting, one and a half or two inches from its end, an oblong opening of size proportioned to the volume of the stone. The canula having been introduced in such a way that the calculus corresponds to the opening, and projects into the interior, begin by moving on it a rasp, and then a file, which you pass and repass on the calculus, whilst an assistant compresses it against the opening in the canula. If there remained any small portion of stone inaccessible to the file, it should be forced out from its cell, with the forceps of Hales, or a special crochet.

4. *Incision*.—Begin by exactly marking the spot occupied by the stone, and charge an assistant to draw the skin of the penis towards the glans, so that the external incision may not be parallel to that of the urethra. The surgeon fixes the stone between his left thumb and index-finger, and with his right hand, armed with a bistoury, he makes a longitudinal incision in the skin, a little longer than the diameter of the foreign body; and by a second incision, made with the point of the knife, pressing on the calculus, he divides the parietes of the urethra itself. If the stone is very uneven, and its volume allows of the introduction of a director, the bistoury should be directed on the latter, and the incision would then be cleaner.

The incision finished, the penis is drawn up, and pressure made with the fingers on the lateral parts, to render the calculus more prominent. Sometimes it escapes in this way, almost by itself, at others it may be seized and extracted with a curette, the end of a spatula, or a ring forceps. When the stone is arrested opposite the scrotum, the fear of infiltration has caused it to be advised to have recourse to incision as late as possible, and not till after all the other means have been tried without success. These fears are much exaggerated. I lately performed this operation for a double calculus, corresponding to the base of the scrotum, and left a permanent sound in the bladder, and the patient recovered without any kind of accident.

(8.) *Abnormal Dilatation of the Urethra.*

From a patient affected with incontinence of urine, and whose urethra offered a considerable dilatation, Habort thought of cutting away part of the inferior wall, and then re-uniting the wound by means of suture, and he thus succeeded in re-establishing the urethro-vesical functions (Velpéau).

(9.) *Tumours of the Prostate.*

This term is applied to more or less voluminous tumours, generally oval, which springing from the middle and inferior part of the prostate, project into the bladder, and often become applied to the orifice of the urethra, in such a way as to plug it up. Sabatier cites a case of this kind, in which puncture over the pubis was performed, and the canula left in continually for an entire year, without being followed by any accidents. It was for an analogous affection that Lafaye punctured through the urethra. But M. Leroy has found a still less hazardous mode of treatment.

Proceeding of M. Leroy d'Étiolle.—His intention is to strongly depress the middle and projecting part of the prostate. He introduces into the bladder an ordinary gum-elastic sound, with a curved stylet, and then straightens this sound by introducing into it a straight stylet. This sound is left *in situ* twenty minutes, and re-introduced every day for eight or fifteen days. M. Leroy, himself, avows that he cannot well explain the efficacy of this method; but experience has shown that the patients were freed from their retention of urine, if not for ever, at all events for several months, and even during many years.

The difficulty is, the introduction of the straight stylet, caused by the curve given to the sound by the tumefied prostate. M. Rigal places in the extremity of the sound, the spring of a bracer; and its stylet should present a corresponding screw at its extremity. By turning this stylet between the fingers, the screw engages itself in the twist of the metallic spring, and so penetrates to the end of the sound. M. Leroy has transported this mechanism to the entrance of the sound, by means of a mouth-piece, grooved on its interior, to receive a screw, and which can be applied to sounds of any caliber. The stylet is passed through this screw, and bears, at its internal extremity, a button or olive, which prevents it from tearing the tissue of the sound.

But these instruments have this inconvenience, that the stylet only proceeds successively from behind forwards, pressing on the posterior wall of the sound; if anything stops it, the curve of the sound becomes angular, and if you persist you may tear the tissue of the sound, and even wound the canal.

M. Tanchou wished to avoid the danger by joining to the sound an articulated stylet, which is introduced with it, and afterwards serves to straighten it. We should add that all these inventions are perfectly useless; when the metallic sound, with the ordinary curve, is used, as soon as the curve has penetrated into the bladder, the urethra is naturally occupied by the straight portion of the instrument; and you are still surer of the result in using the sound of M. Mercier with a small

curve, which then serves at the same time to recognize the hypertrophy, and to combat it.

(10.) *Puncture of the Bladder.*

This puncture is performed with the trocar, straight or curved, of sufficient length, and in four different proceedings.

I. BY THE URETHRA. *Proceeding of Lafaye.*—Astruc suffered from a retention of urine, caused by a tumour of the neck of the bladder; catheterism being impossible, Lafaye took a bougie, with a slight curve, open at both ends, and containing a stylet, terminated by a triangular point, which could pass one-third of an inch beyond the opening of the bougie. He introduced the bougie, with the point withdrawn inside it, as far as the obstacle, passed his index-finger deeply into the rectum, to direct it towards the bladder; then he pushed the stylet forcibly across the obstacle, and at the same time passing the bougie in the direction of the neck of the bladder, he reached the cavity of this organ. He then withdrew the stylet, left the bougie in the bladder for fifteen days, and then substituted for it other sounds, of a large size, so as to create an artificial canal there.

II. PERINEAL PUNCTURE.—It is performed with a straight trocar, six or seven inches long. The patient is laid horizontally, with his legs and thighs fixed as for perineal lithotomy, an assistant slightly compresses the bladder in the hypogastric region with one hand, and raises the scrotum with the other. The surgeon, standing between the patient's thighs, applies his index-finger on the side of the raphé, between the urethra and ramus of the ischium, half an inch in front of the anus, to put the perineum on the stretch, and more surely direct the point of the trocar, or puts his finger into the rectum, to remove the intestine, as much as possible, from the place where puncture is to be made. He takes the trocar in his right hand, and places its point on the middle of a line, which, starting from the tuberosity of the ischium, finishes at the raphé, two lines in front of the margin of the anus. The instrument should be so passed in, that its point may meet the axis of the body, two or two and a half inches from the situation of its entrance, according to the *embonpoint* of the subject, and the presumed thickness of the perineum. The escape of a few drops of urine which flow along the canula of the trocar, and the want of resistance, indicate that you have reached the bladder; then withdraw the trocar, cork up the canula, which is left in, and fix it to the thighs by a T bandage. The parts traversed by the trocar are:—the skin, an abundant cellulo-fatty tissue, the levator ani muscle, and the base of the bladder, near its neck.

III. PUNCTURE BY THE RECTUM. *Proceeding of Fleurant.*—This proceeding is founded on the anatomical fact, that in ischuria the base of the bladder forms a tumour, very perceptible to the touch, in the rectum, which compresses this intestine to such an extent as to render evacuation of the fæces impracticable.

The patient being placed as for perineal puncture, the surgeon introduces his left index-finger, greased, into the rectum, as far forward as possible beyond the prostate, and until he very distinctly feels the

tumour formed by the bladder. He then takes, in his right hand, a curved trocar, four or four and a half inches long, the piercer of which has been withdrawn into its canula, and passes it along his right index-finger, on which its convexity rests. When the extremity of the canula has reached beyond the end of the finger, and touches the anterior wall of the rectum, the handle of the trocar is pushed forwards to cause its point to project, and at the same time to cause the piercer and canula together, to enter the bladder at a distance of one inch above the prostate, and between the vesiculæ seminales. The finger and piercer are successively withdrawn, and the urine flows away by the canula. When the bladder is emptied, the canula is fixed by means of ribands or tapes, passed through the openings of its rim, and attached in front and behind to a body bandage; and secured in its position, by means of compresses, maintained by a double T bandage. Moreover, you may cork it with a peg, or, as the patient is obliged to remain in bed, keep it open, and make it communicate with a utensil placed under his nates. When the patient has need to go to stool, the bandage is removed; the canula being gradually raised, and supported, whilst the faecal matters come out. Lastly, as soon as the urine has regained its natural passage, the canula is withdrawn, and the opening it made is soon healed.

IV. PUNCTURE ABOVE THE PUBIS.—When the bladder is distended with urine, it rises above the pubis, pushes back the peritoneum before it, and applies its anterior surface immediately against the recti, and transversales abdominis muscles. For this puncture the trocar of Father Côme is used; it is about four inches long, mounted on a handle, and representing in its curve, a portion of a circle six inches in diameter. The patient lying on the right side of his bed, his head and breast slightly elevated, his legs slightly flexed; the surgeon, placed on the same side, extends the skin with the thumb, and index-finger of his left hand; and seizing the curved trocar in his right, with its concavity turned towards the pubis, he plunges it in perpendicularly to the axis of the body, and in the middle of the linea alba, one inch and a half above the symphysis pubis, into the bladder. When you have entered its cavity, withdraw the piercer, and draw off the urine; then cork the canula, and fix it round the body with two ribands fastened to its rim. The canula is left in the bladder until the natural course of the urine is re-established, and you can introduce a sound by the urethra. It should be uncorked from hour to hour, to allow the urine to flow off, the patient leaning on one side; at the end of six or eight days the passage it traverses is lined by a sort of adventitious mucous membrane, and you may withdraw the canula without fear of extravasation.

Appreciation.—Puncture over the pubis is generally preferred, on account of the thinness of the parts it traverses, and the absence of important nerves and vessels. In fact, when the patient is covered with fat, it is necessary to make with the bistoury, an incision across all the fatty layer, before plunging in the trocar: but this inconvenience is still more marked in perineal puncture; and in puncture of the rectum, the thickness of the adipose tissue of the perineum is

sometimes so great that you cannot reach the bladder with your finger : a circumstance met with by Frank, and attributed wrongly to elevation of the bladder through its fulness. We only cite puncture by the urethra as a reminiscence. Boyer substituted the forced passage of a catheter ; which, perhaps, does not deserve such complete disdain. In all these proceedings, when a permanent canula is to be left, it is prudent to replace the metallic canula by a gum-elastic sound, of small size, which is passed into the bladder through its canal.

SECTION IV.—OF LITHOTOMY.

The operation of lithotomy (*la taille*) consists in cutting into the bladder in order to extract from it the calculi it may contain. It has been tried by a number of proceedings, which however may be classed under three principal methods ; *perineal lithotomy*, *recto-vesical lithotomy*, *hypogastric lithotomy*.

(1.) *Perineal Lithotomy.*

Surgical Anatomy.—The perineum represents a triangle, circumscribed laterally by the arch of the pubis, and behind by a line extended from one sciatic tuberosity to the other. The median raphé of the skin subdivides it into two lateral triangles. It is through one of these triangles, and especially that of the left side, sometimes also through them both, that the bladder is reached in the different kinds of perineal lithotomy. In fact, from the skin to the bladder, each of them offers a kind of passage, filled with parts of slight importance, or that may be avoided.

For instance : 1. On the *median line*, you find the skin, the superficial perineal aponeurosis, the accelerator urinæ, *e*, and the sphincter ani, *g*, the spongy portion and bulb of the urethra, *n*, its muscular portion, the middle aponeurosis of the perineum, the prostate, the neck of the bladder, and the rectum in the whole depth of the perineum.

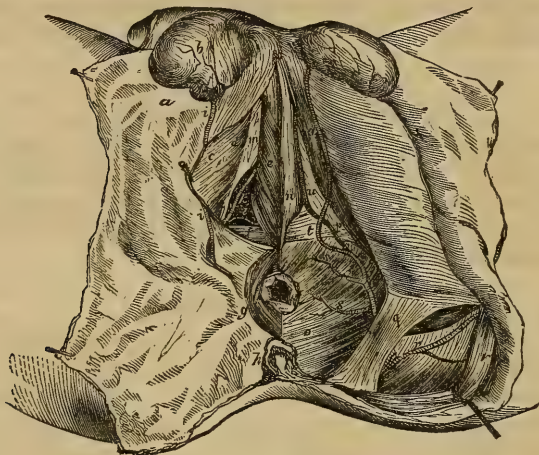
2. On the *external side* of the triangle, the skin, a layer of cellulo-fatty tissue in the thickness of which pass the superficial artery and nerve of the perineum, *i* ; the erector penis muscle, *d* ; the root of the corpus cavernosum, *m* ; the ascending ramus of the ischium, and the descending ramus of the pubis, the internal pudic artery and nerve, *k* ; the middle perineal aponeurosis, the levator ani muscle, *o*, the deep or pelvic aponeurosis, a venous plexus, and the lateral parts of the body of the bladder.

3. At the *posterior border*, the skin, the external sphincter, the inferior hemorrhoidal artery, *s* ; higher up, the rectum on the inside ; on the outside a fatty tissue, traversed by arterial and venous branches of different sizes.

4. Lastly, in the *area of the triangle* you find in layers : the skin, a layer of cellulo-fatty tissue, more or less thick, according to the general and local *embonpoint*, and in this tissue oblique branches of the superficial artery and nerve of the perineum ; the transversus perinei muscle, *f*, in front or towards the anterior angle of the triangle ;

the middle perineal fascia, the levator ani, the deep fascia, some nervous branches going to the prostate, a nervous plexus; lastly, in the adult male, the bladder, placed at the summit of the triangular pyramid represented by these parts, the apex of which it forms.

Fig. 23.



Anatomy of the perineum:—superficial dissection on the right side, deep on the left;—*a*, the integuments reflected with the fascia superficialis and held back by a pin; *b*, testes; *c*, superficial perineal fascia dissected off with *d*, erector penis muscle; *e*, accelerator urinæ; *f*, transversus perinei; *g*, sphincter externus; *h*, coccyx; *i*, superficial perineal artery; *j*, internal pudic artery running along the rami of the pubis and ischium; *k*, artery of the bulb; *l*, corpus cavernosum; *m*, the bulb and urethra laid bare; *n*, erector penis; *o*, the ischio-rectal space, from which the fasciæ and fat have been removed, exposing the levator ani; *p*, the deep perineal fascia (triangular ligament); *q*, sacro-sciatic ligament; *r*, the ischiatic and internal pudic, arising from a common trunk—the internal pudic is pulled out a little from under the ramus of the ischium; *s*, hemorrhoidal arteries; *t*, superficial perineal artery; *u*, internal pudic artery; *v*, gluteus maximus—it is detached from the coccyx and its edge is pulled back to show the parts beneath it.

This organ presents to us beneath the symphysis:—1. On the median line and from behind forwards, the inferior part of its anterior wall; a triangular surface, resting on the pelvic fascia and prostatic ligaments; the prostate, traversed by the urethra; and lastly, the rectum.

2. The external border of this triangular surface placed on the ascending ramus of the pubis. It is especially in the direction of this border that the bladder is more or less bare, and may be incised with the greatest facility.

3. The posterior, formed by the prostate and lateral parts of the bladder, rests on the rectum, from which it is separated by a layer of cellular tissue, of moderate thickness, but of a pretty large extent in width, and into which the point of the lithotome, or the extremity of the forceps, has more than once gone astray.

The extent and depth of this canal vary. On twenty subjects measured inside the sciatic tuberosities, the extremes of the distance apart were two inches and two lines, and three inches and seven lines. From the skin to the internal orifice of the bladder, the pelvimeter, found on a like number of subjects, from one inch and two lines to

four inches and four lines; average thickness, two inches and four lines. (Dupuytren.)

These remarks, though very important, have but a secondary interest compared with the following facts.

The three difficulties of the operation in perineal lithotomy are—the avoidance of the vessels and rectum, and the opening of a free passage for the calculus. The blood may flow from the bulb, or from the arteries and veins. The bulb terminates behind, ordinarily ten or eleven lines from the anus, sometimes half an inch, or even still less, especially in old men, in whom also the veins form a plexus, often very voluminous, around the prostate. The arteries to be feared are three in number.

1. The *pubic artery* resting against the pubic arch, protected by the bones and falciform ligament. The incision to wound it, must be carried as far as the internal surface of this arch. 2. The *superficial perineal artery*, which generally follows the internal border of the erector penis muscle. Lastly—3. The *transverse* or *bulbous artery*, which passes almost transversely to the extremity of the bulb. Excepting, then, in cases of anomaly, which are numerous, you see that by commencing your incision behind the bulb, and directing it obliquely backwards and outwards, you are almost sure to avoid all these vessels.

As to the rectum (the relations of which will be pointed out at greater length for recto-vesical lithotomy), it is only necessary here to know, that in old men the portion of this intestine that corresponds to the prostate, is often dilated in such a manner, that it forms on the sides of this gland two anterior projections, between which the prostate buries itself as it were. In order to avoid wounding it in this point, we must take care to empty it of fecal matter; plunge a finger into it to put it away from the knife during the incision; and lastly, it is generally recommended not to prolong this incision beyond the limits of the prostate itself.

The parts that may oppose the exit of the calculus are the bones, the perineal aponeurosis, and lastly the prostate. M. Senn has observed that in an ordinary pelvis, the superior part of the prostate corresponds to a distance of nearly two inches from the bones, its middle part to a distance of two inches and two lines, and its inferior to two inches and five lines.* There is no obstacle, then, on this side, unless with calculi of enormous dimensions. He has demonstrated also, that after the ordinary incision, the aponeuroses of the perineum in no way oppose the passage of the stone. The difficulty, then, comes solely from the prostate. It should then be seen in what extent the dimensions of this organ permit its division and the formation in it of an opening sufficiently large for the passage of the stone. Up to the age of fifteen years the prostate is, so to say, only rudimentary, and takes scarcely any share in the general development. Between the prostate of a child four years old and that of a child

* The pubic surface of the prostate is six or eight lines distance from the symphysis pubis; and its lateral surfaces near about the same distance from the rami of the pubis and ischium—Velpeau, Anat. Chirur. tom. ii. p. 236.

twelve years old, there is scarcely any difference in volume. In carefully made researches on more than forty subjects, of from two to twelve years, M. H. Bell found it thus:—

From 2 to 4 years.		From 5 to 10 years.	
Transverse diameter	6 to $6\frac{1}{2}$ lines.	Transverse diameter	$6\frac{1}{2}$ to $8\frac{1}{2}$ lines.
Posterior oblique radius	$2 - 2\frac{1}{2}$ "	Posterior oblique radius	$2\frac{1}{2} - 3\frac{1}{2}$ "
Anterior oblique radius	1 line.	Posterior direct radius	$2 - 2\frac{1}{2}$ "
Anterior direct radius	$\frac{1}{2}$ "		
From 10 to 12 years.		From 12 to 15 years.	
Transverse diameter	8 to $9\frac{1}{2}$ lines.	Transverse diameter	$9\frac{1}{2}$ to 11 lines.
Posterior oblique radius	$3 - 4$ "	Posterior oblique radius	4 " "
Posterior direct radius	$2 - 2\frac{1}{2}$ "	Posterior direct radius	$2 - 2\frac{1}{2}$ "
Anterior direct radius	$1 - 1\frac{1}{2}$ "	Anterior direct radius	$1\frac{1}{2}$ "

These dimensions are only applicable in the normal condition. Three times M. Bell saw the urethra approximate to the posterior part of the gland, and once to its left lateral part.

In the adult, according to the calculation of M. Senn, the prostate is one inch and two lines long from before backwards in the median line, and one inch and three-quarters wide at its middle part.*

The length of radii starting from the urethra to the circumference of the gland are:—

From the urethra to the inferior and middle portion seven and a half to nine lines.

From the urethra directly outwards ten lines.

From the urethra to the inferior and external part, eleven lines to one inch.

The prostatic portion of the urethra being capable of receiving a sphere of four lines and a half diameter, or an inch and a line and a half circumference, by adding to this constant quantity double the incision made—which is like a button-hole, the borders of which may be separated—you can calculate in a precise manner the capacity of the opening made. For instance, the transverse opening on one side can only be about ten lines in length, which gives an entire opening of two inches and nine lines circumference, and allows to pass a spheroidal body ten or eleven lines in diameter. The incision, oblique downwards, may be from eleven lines to an inch long, and afford an opening three inches and a line in circumference, enough for a calculus one inch in diameter. (Senn.)

If the prostate is incised on both sides, the transverse incisions being each nine or ten lines long, give an opening four inches five lines and a half in circumference, permitting the extraction of a calculus one inch and a half in diameter. Two perfectly oblique incisions form an isolated triangular flap, the base of which is one inch and three-fifths

* Cruveilhier says, "The vertical diameter is twelve lines, transverse eighteen, antero-posterior or length fifteen."

Velpéau—"From before backwards, that is to say, from the base to the summit, its greatest diameter is from nine to fifteen lines; and the radii, from the urethra to different parts of the circumference of the gland are, the inferior radius from three to six lines long, rarely more; directly transverse from five to eight; and downwards and outwards from eight to ten."—Anatom. Chirurg. tom. ii. p. 236.

in extent: this flap, lowered in front, lays bare a triangular opening, the perimeter of which is formed by the base of one inch and three-fifths; the two sides are each about eleven lines, and the superior half of the urethra six lines and a half in extent—together a little less than four inches; consequently less than that of the transverse opening—a result you would be far from expecting.

The incision which permits the largest opening would be composed of an oblique incision to the left, eleven lines or an inch long, and another transverse to the right, three-quarters of an inch or ten lines long. This, with the dilatation of the urethra, gives an opening (*une boutonnière*), easily expanded, and of four inches and eight lines circumference. This is the opening preferred by M. Senn.

But you must not absolutely rely on these calculations. When the prostate is healthy, the edges of its section may bear a dilatation, of which M. Senn has not taken notice. When it is hypertrophied, you may incise it much farther.

Finally, all this is founded on the surgical doctrine, that incisions should never pass beyond the circumference of the prostate—an axiom the value and necessity of which we are far from admitting.

Methods of Operation. General Dispositions.—Perineal lithotomy is performed by three methods, called Median lithotomy, Lateral lithotomy (*taille latéralisée*), and Bilateral lithotomy. A fourth method of lateral lithotomy has long since been rejected from surgery. We shall precede the description of them by some general rules concerning the position of the patient, the extraction of the stone, and the accidents consecutive to the operation.

In the hospitals there is a particular bed for lithotomy; but in private practice a solid table or commode, or any other analogous piece of furniture about one yard high and nearly one yard and a half long, is chosen. It is covered with a mattress, which does not pass beyond the edges of the table, but is folded double at one end and fixed with cords. Lastly, according to necessity, one or two pillows are added, to slightly elevate the patient's head. The mattress is covered with a sheet several times doubled, and placed so that it may hang down in front, to within ten inches of the floor. Under this sheet should be placed a basin, containing sand or ashes, to catch the blood and urine.

The perineum should be shaved beforehand. The patient is laid on the bed, in such a way that his body may be in the horizontal position, his head slightly elevated, his pelvis on a level with the edge of the bed, so that his perineum may even project slightly forwards. The thighs should be flexed at a right angle on the pelvis, and the leg at an acute angle, so that the calf may touch the posterior part of the thigh. The arms are extended along the body, and each hand brought to the corresponding foot, which it embraces, so that the four fingers rest on the sole, and the thumb on the dorsum of the foot. Two assistants keep these parts together in contact. The surgeon, folding a tape double, and making a running knot at its middle, passes the patient's hand into the knot, and tightens it. It should remain placed on the outside of the wrist; then one end of the tape is taken and made to pass from without inwards over the thumb and dorsum

of the foot, and brought back from within outwards over the tendo Achillis; then it is brought from without inwards over the instep; then on the internal side of the leg and wrist; and lastly, it is directed from without inwards on the foot, and these different turns repeated, until not more than seven or eight inches of tape remain. The other half of the tape is applied in the same manner, but in the opposite direction, and the two ends are tied in a simple knot maintained by a bow. The tape thus placed forms a figure of 8, which embraces in one part the hand and foot, in the other the inferior part of the leg and wrist, and which very strongly secures these parts together. Whilst the surgeon fastens one of the feet in this manner, an assistant does the same on the other side. At least five assistants are necessary; two of them to maintain the legs and thighs, applying the forearm that corresponds to the patient's head on the internal part of the knee, and on the superior and anterior part of the leg; the other hand on the instep, and not under the sole, which would give the patient a point to push against in his involuntary movements. A third assistant, the most skilful and intelligent, is charged with holding the catheter: he should stand at the right hand of the patient, near the one who holds the leg. The fourth, placed behind the patient's head, lays his hands on his shoulders, to prevent him from rising; the fifth stands at the right of the surgeon, to hand to him and receive back the instruments.

Many surgeons at this period introduce a silver sound, to again recognize the calculus; and, unless it can be felt, the operation should be put off. When the calculus is found, the catheter is replaced by a grooved staff. Boyer makes these researches, and introduces the catheter, before placing the bandages. It is, in fact, more easy for the surgeon to pass the sound standing on the left side of the patient, than between his legs; and, moreover, it is useless to apply the bandages before having definitely fixed on the operation. Lastly, Velpeau advises to banish the employment of these bandages, and to trust in the assistants. This is doubtless more simple, but not so sure.

Whatever proceeding is adopted, as soon as the incisions are made, and the instruments withdrawn, the index-finger is passed into the wound to ascertain its extent, and, if necessary, to gently dilate it. In young or thin subjects, this finger may recognize the situation, shape, and size of the calculus, and direct the forceps to it. But in very fat subjects, or those whose prostate is large, the finger is not long enough, and it is better to have recourse to the gorget. The index-finger is placed in one of the angles of the wound, if there is room enough, in the lower angle; then the gorget is taken in the right hand: its concavity is applied on the radial border of the finger, and it is pushed on gently, directed obliquely from below upwards. When it has reached into the bladder, the finger is withdrawn, and the instrument turned on itself, so as to bring its concavity upwards and its convexity downwards.

To introduce the forceps, embrace their rings with the thumb and three last fingers of the right hand, the index-finger extended along their branches, avoiding pressure on the latter when you use crossed

forceps, this position tending to separate their spoon-shaped beaks. The gorget or finger being placed in the inferior angle of the wound, pass the forceps along it, taking care to direct the edges of the beaks in such a manner that their convex surfaces may correspond to the lips of the wound.

The forceps having entered the bladder, which is easily known by the depth to which they have penetrated, and the want of resistance, if the gorget has been used, a half turn to the left must be given to both instruments, by which means the gorget becomes superior to the forceps, and may be more easily withdrawn. In a word, in all these movements of the instruments it is the posterior part of the wound that must be taken most care of; the anterior wall being constituted by the superior wall of the urethra, which the incision has not at all affected.

Move the forceps (closed) about gently in the bladder to recognize the situation of the stone. You must know that the most usual situation of calculi, especially when there is but one, is at the posterior part of the base of the bladder. There the single calculus, generally elliptical and flattened on two of its surfaces, is laid across, and touches the base of the bladder by its most extended surface (Amussat).

Direct the forceps according to these indications; seize with each hand one of its branches; if the stone presents itself at the end of the instrument, you need only separate them, and push them on a little, to engage it in the interval between them. If it corresponds to their superior edge, it falls between them by its own weight, as they are separated; if it is beneath them, separate them, and turn them half round, so that one of them may be below, and the other above the stone. When the stone is very small, and the bladder large, it avoids the forceps that seek it; in this case, you must pass the spoons of the forceps along the base of the bladder, separating them and bringing them together, alternately, until the stone is engaged between them.

When the base of the bladder presents a considerable depression, it becomes necessary to use curved forceps, the concavity of which is directed downwards, to seize the calculus; but, when it is seized, the concavity of the forceps is turned upwards, and it is withdrawn in such a way as to describe a curve in coming out, which corresponds to that presented by the os pubis.

When the stone is very large, and presents itself by one of its long diameters, and you are unable to correct this unfortunate position with the forceps, withdraw them, and place your finger in the bladder, and with it disengage the stone, and try to bring one of its extremities to the neck of the bladder. This introduction of the finger does not always succeed in adults, on account of the depth of the wound; and sometimes it happens that the bladder, thickened and contracted on the stone, does not allow the forceps to manœuvre with security; you must then pass the forceps as far forwards as possible, open it by degrees, to put away the parietes of the bladder, and give room for the instrument; seize the part of the stone that presents itself, and, by means of a half turn to the right and left, given it by the instrument, disengage the calculus from the cavity of the bladder, and bring it

towards its neck; then open the forceps to push them on more forwards, and embrace the stone with more force, or with more convenience: and, if the calculus obstinately presents its largest diameter to the forceps, place the instrument, without letting go the calculus, in such a way that one of its spoons corresponds to the base of the bladder, and the other looks upwards; then take it in the left hand, and introduce the director between the ends of the forceps, which are then relaxed a little; push the stone so as to change its position, and reiterate these attempts until, on bringing together the branches again, you recognize that their separation is less considerable, and, consequently, that the stone is better situated. Then turn the forceps by a movement of rotation, to assure yourself that the bladder is not seized with the stone; after which proceed to extraction.

The extraction of small stones needs no rules; but, when the calculus is of considerable size, it is recommended to turn the spoons towards the lips of the wound. When the extraction requires but little force, the instrument is held as a scissors; if more is required, the branches of the forceps must be placed between the index and middle fingers, and the rings grasped in the hand; the left hand may also be added, placed on the branches of the instrument, as near as possible to their junction; the four fingers beneath, the thumb above. When the calculus is very hard, which is recognized by the resistance it opposes to the bite of the forceps, it should be squeezed strongly enough to prevent its escape; but, if you perceive that the teeth penetrate easily into it, the pressure should be moderated for fear of breaking it, unless its volume renders this necessary. In which case it is better to have larger bits, and in less quantity, than a number of little morsels, which would necessitate repeated manœuvres of extraction.

The stone is drawn out directly towards the operator. If it is not large, this simple traction suffices; if it is of greater bulk, it must, at the same time, be drawn to the operator, and the branches of the forceps must be alternately elevated and depressed, to disengage successively the superior and inferior parts of their beaks. In these movements care must be taken to lean on the inferior part of the wound, so as to be farther removed from the angle of the os pubis, the spot where the passage is most narrowed, and the resistance insuperable. The index-fingers of the left hand, passed into the inferior part of the incision at the moment when the branches of the forceps are elevated, may be of use in disengaging the beak of the instrument and the stone. When the prostate is passed, no further obstacle is met with, unless the incision of the skin is too small; in which case it is enlarged inferiorly with a common bistoury. The essential rule of all these manœuvres is to proceed gently and circumspectly.

The curette serves on two occasions. 1. When the calculus, having escaped from the forceps, remains in the middle of the wound. 2. To withdraw from a bladder the smallest fragments of a stone that is broken; as to the portions reduced to powder, injections are made into the bladder to wash them out, or, at all events, to collect them into the base of the bladder, where the curette can more easily lay

hold of them. When the stone is too large to be extracted through the incision made in the prostate, the resources are numerous. When only one incision has been made, as in the lateral operation (*taille latéralisée*), Boyer advises replacing in the bladder without withdrawing the forceps, which are confided to an assistant, the lithotome caché set at No. 5; it is guided by the left index-finger, and its edge being turned towards the incision already made, the entire thickness of the prostate is divided in withdrawing it, without prolonging it farther; for the neighbouring cellular tissue opposes no resistance to the extraction of the stone. In addition to the difficulty of exactly abiding by this precept, we think it would be more prudent to prolong the incision with the bistoury, than to risk enlarging it by tearing. Moreover, the danger is not greater when once the limits of the prostate, so sacred to our modern surgeons, are passed.

To those who fear making the incision in this manner, the double incision of Dupuytren; or, again, that of Senn; or, perhaps, the quadri-lateral incision of M. Vidal, offer varied resources. It is useful to remember here, that with his double incision, giving it its extreme length, M. Senn thinks it is impossible to extract calculi of more than one inch and six lines in diameter, "unless by horribly tearing the parts;" and, with the single incision, of more than from one inch to one inch and one line. Nevertheless, Boyer thinks you may still try extraction, when the size of the stone is such that, being seized in the most favourable manner, the beaks of the forceps are not separated from each other more than two inches, which requires a space, at least six inches in circumference. The largest calculus ever taken from the bladder through the perineum, the patient being cured, according to the account of Deschamps, required an opening seven inches in circumference. No matter how much the prostate is dilated, even with quadri-lateral lithotomy, it seems to us impossible to stretch it to this extent. I think that, instead of inevitably tearing it, incision is much to be preferred. I have reported in my *Anatomie Chirurgicale* some curious experiments of Deschamps on this point.

When the calculus is extracted, the finger or sound should be passed into the bladder to see whether it contains others. If the one you have withdrawn presents any smooth surfaces, it is a sign that it was not alone; but the absence of smooth surfaces should not make us neglect this search for others. They must all be extracted before the patient is sent back to bed; unless you fear that his strength will fail, either on account of the length of the operation, the violence of the pain, or hemorrhage; then the accomplishment of the extraction is put off to another time.

The most embarrassing circumstance is, when the calculus is encysted. Littre advises, in this case, seizing the tumour, formed by the stone, with a forceps, and squeezing it gently several times, so that, the folds of the mucous membrane that cover the calculus being thinned and torn, it may fall into the cavity of the bladder and may be extracted afterwards in the ordinary way. This proceeding succeeded with Boyer. But when you can reach the tumour with the finger, he recommends, in preference, incising it with a concave bistoury, sharp

only at its point, and enclosed in a sheath in imitation of the lithotome caché; or, with a button-pointed bistoury, with a narrow and long blade, sharp only at its extremity, and guided along the index-finger. Lastly, if the cyst existed at the posterior part of the bladder, and within reach of the finger, it might be seized through the wound with a polypus forceps; and, at the same time that it was pulled, it might be pushed from within outwards by the index-finger, introduced into the rectum (Rognetta).

It remains to say a word on the consecutive accidents. The only one that needs the assistance of operative surgery is hemorrhage, recourse is then had to two methods—ligature and plugging.

I. LIGATURE. *Proceeding of Boyer.*—He uses the ligature-needle of Deschamps in the following manner. The patient being laid across the edge of his bed, his legs and thighs flexed and held by two assistants, the wound is freed from the clots of blood that fill it, and one or two injections are made into the bladder, if judged necessary; then the left index-finger is passed into the wound, and its extremity applied on the point from which the blood seems to spring, and which, in almost all the proceedings, is at the inferior part of the external wound; if the hemorrhage is stopped, you may conclude that it is there the artery opens; then, without withdrawing the finger, the needle, armed with a flattened waxed thread, is taken in the right hand, and is pushed in on a level with the ulnar border of the finger, which serves as a conductor; it is directed from within outwards, by causing the right hand to execute a movement of rotation, which changes it from a state of pronation to that of supination. In this manner the instrument passes as near as possible to the tuberosity of the ischium, and its point comes out at the side of the radial border of the finger that is in the wound; when the needle is so far advanced that the ligature with which it is threaded can be seen, it is taken hold of with a blunt hook, or dissecting forceps, and disengaged. Then the needle is withdrawn by the same road as it entered; the two ends of the thread are drawn towards the operator with the right hand, whilst pressure is made in the interval between them with the index-finger of the left hand: and, if at this moment the artery ceases to bleed, you may conclude that it is embraced by the thread, the ends of which are tied as usual. When ligature seems impossible, or has been tried without success, recourse is had to plugging.

II. PLUGGING.—It is performed in several ways. Formerly, lint or agaric was tied to a sound, and this sound was placed in the wound in such a way that its beak might plunge into the bladder, and that the agaric or lint might correspond to the point from which the blood flowed.

Boyer employs a gum-elastic canula, which he plunges into the bladder; and, a passage for the urine being well assured by this canula, he plugs the rest of the wound according to the proceeding already described for the rectum.

The proceeding of Dupuytren is more simple and certain. He uses a special silver canula, enveloped in a linen bag, fixed all around it at some distance from its beak. The canula being passed into the

bladder, the bag is filled with lint or agaric ; and you have facility in directing the compression, and making it strongest, on the part that needs it most. When a sufficient quantity of lint has been introduced, it is compressed and retained *in situ* by tightening, as a purse, the external orifice of the bag by means of a cord, passed into a circular hem that forms its border.

I. MEDIAN LITHOTOMY.—Known formerly under the name of the *apparat* major ; renewed in our days by some surgeons.

Proceeding of Vacca Berlinghieri.—Vacca used a bistoury, furnished, at its extremity, with a tongue about two lines long, to enable it to slide in the groove of the catheter more surely. The patient being placed, and secured as usual, he makes an incision in the perineum on the median line, extending from the origin of the scrotum to the anterior border of the anus. The subcutaneous cellular tissue, the superficial perineal fascia, the origin of the spongy portion, and the bulb of the urethra, and the anterior fibres of the sphincter ani externus, are then divided in the same extent and direction. The nail of the left index-finger, passed into the wound, serves to guide the knife, and direct it towards the groove in the catheter. When it has entered the groove, the surgeon taking the handle of the catheter in his left hand, elevates it under the symphysis pubis ; whilst, with his right hand, he passes the knife into the neck of the bladder, to a depth of four or five lines, the edge remaining parallel to the median line. Having reached into the bladder, the blade should be depressed and separated from the catheter, whilst its heel remains rested on the groove in the latter ; and the knife is withdrawn in this new direction, so as to incise the parts of the neck of the bladder and prostate, or of the membranous portion which might have been spared in entering, and to enlarge the opening destined to serve for the passage of the calculus ; the left index-finger passed into the wound serves to measure its dimensions ; and if, notwithstanding the manœuvre indicated above, it seems still insufficient, the knife directed on it serves to enlarge it to the requisite degree. This proceeding gives only a very small opening of the prostate ; but you might join to it the proceeding of Dupuytren, who, after making the external incision, passed the lithotome caché of Côme into the bladder, turned the edge directly forwards, and, in withdrawing it, with the blade open, vertically, divided the anterior portion of the neck of the bladder, the prostate, and a portion of the urethra.

In the *apparat* major, the neck of the bladder was dilated with special instruments. Guérin, of Bordeaux, advised after incision, made almost like Vacca's, the introduction of a stalk of dry carrot renewed every morning, to dilate the wound, and not to extract the calculus until after several days.

II. LATERAL LITHOTOMY (*taille latéralisée*). *Proceeding of Frère Côme.*—The apparatus consists of the following objects : 1. A grooved staff, as large as possible, according to the age of the patient. 2. A straight and a convex bistoury. 3. The lithotome caché of Frère Côme, which is too well known to need description. 4. Straight forceps of different sizes, and a curved forceps. 5. A common gorget,

a curette, and a sound. 6. An injection syringe, the canula of which is six inches long, and ends in an olive-shaped spout, like the top of a watering-pot. 7. A silver or gum-elastic canula, furnished with a linen bag in case of hemorrhage. 8. A basin of oil to grease the instruments with, and another containing hot water. 9. An ordinary dressing apparatus. Lastly—10. Two bands of thread, flannel, or list, of the breadth of two or three fingers, and four yards long, used to bind the patient.

The patient and assistants being placed as we have described, the surgeon—standing, sitting, or, with one knee bent on the ground, between the patient's thighs—introduces the staff in a direction perpendicular to the axis of the body, inclines its handle towards the patient's right groin, and gives it to an assistant to hold. If the scrotum is small, he raises it with the ulnar border of the left hand strongly pronated, and extends the skin of the perineum transversely with the thumb and index-finger: but, if the scrotum is large and pendulous, the assistant, who holds the staff, raises it with his left hand, avoiding compressing the testicles and dragging the skin of the perineum too much upwards. The surgeon takes the convex bistoury in his right hand in the first position, and makes, in the skin and cellulofatty tissue of the left side of the perineum, an incision commencing on the raphé, about one inch in front of the anus, and terminating at the middle part of a line extended from the anus to the summit of the tuber ischii. The length of this incision should vary according to the age and stature of the patient. If the subject is fat, it is seldom deep enough. It is then completed by dividing little by little the cellulofatty tissue.

The surgeon then passes his left index-finger to the bottom of the incision to recognize the situation of the staff. When he is separated from it only by a thin layer of the parts, he places his finger so that its radial border looks downward and its ulnar border upwards, and that the left edge of the groove in the catheter may be lodged in the depression that separates the nail from the pulp of the finger. Then, seizing the straight bistoury as a pen, it is passed flat on the nail of the index-finger, and its point pushed into the groove of the staff through the walls of the urethra. The contact of the two instruments makes the operator aware of the success of this manœuvre. He then immediately changes the situation of the finger, the pulp of which he places on the back of the bistoury, and presses gently on it, whilst he pushes it forwards with the right hand, elevating its handle slightly, to cause its point to slide in the groove of the catheter; then he depresses the handle to make it describe an arc of a circle from before backwards round the point, which rests immovable, and cut all the part of the urethra that covers its point. The incision of the urethra should be about three-quarters of an inch long, and only affect its membranous portion. The bulb is pushed to the right as much as possible; but in very fat people it is almost impossible to entirely avoid it.

When the urethra is incised to a sufficient extent, and the operator feels the catheter bare under his finger, he replaces this finger as it

was at first ; that is to say, so that the left edge of the groove may be between the pulp and nail of the finger. The lithotome caché, being first arranged so as to open to a proper extent, is then taken and held by its handle, the three last fingers placed beneath, the thumb above, and the index-finger stretched along the shank of the instrument ; the tongue at its end is passed on the nail into the groove of the catheter. It is known to be there by the grating of the two metallic instruments on each other. Then with the left hand he takes the staff, which the assistant gives up, and raises this instrument under the arch of the pubis, whilst he pushes the end of the lithotome from below upwards, keeping the tongue always applied against the groove of the staff. This simultaneous movement of the two instruments from below upwards is of the greatest importance : by means of it a space is left between the convexity of the staff and the inferior wall of the urethra, through which the lithotome can enter the canal.

Then the surgeon brings the handle a little towards himself, and at the same time pushes the lithotome and makes it slide in the groove of the staff to the cul-de-sac that terminates it. He then disengages it from the staff, seeks the stone with its point, and, having assured himself by contact with it that he is in the bladder, he withdraws the staff. It only remains to incise the prostate and neck of the bladder in withdrawing the lithotome. To do this, the surgeon passes the shank of the instrument under the arch of the pubis, and presses against the right os pubis, taking care that the shank be introduced far enough forwards to pass one inch beyond the neck of the bladder. He seizes the part of the instrument, where the blade joins the shank, with the thumb and index-finger of the left hand, to hold it firm against the arch of the pubis, and causes the lithotome to execute a slight movement of rotation on its axis, which gives to the edge of the blade the same direction as the external incision. Then he presses with the four fingers of his right hand on the handle of the blade strongly enough to apply it against the handle of the instrument, and cause the blade to come out from its sheath. Lastly, he withdraws the opened instrument towards himself in a perfectly horizontal direction, until he judges, by the length to which it is come out from the wound, and by the want of resistance, that the prostate is divided ; and he finishes by withdrawing it entirely, depressing the wrist not to incise too deeply the fatty parts near the rectum.

The grand art in withdrawing the lithotome from the bladder consists in giving it a perfectly horizontal direction, and bringing out the edge of the blade in the direction of the external incision. By too much elevating the handle, you risk wounding the base of the bladder ; by too much depressing it, you may make too small an incision ; by directing the blade too much outwards, you may wound the arteries of the perineum ; and, too low down or behind, the rectum. The two last are the inconveniences most difficult to avoid. Boyer, to obviate them, recommends the following proceeding.

Proceeding of Boyer.—For ordinary-sized calculi he opens the instrument to No. 9 only, and never beyond No. 11, no matter how large the calculus, enlarging the incision afterwards, if necessary.

Instead of pressing the shank of the lithotome against the arch of the pubis, he applies it against the inferior part of the neck of the bladder, to bring it near the widest part of this arch; he applies the concave part of this shank against the ramus of the right pubis, so that the edge of the blade is turned almost directly outwards; he opens it and withdraws it in this direction; and, as soon as he is made aware by the signs pointed out that the prostate is divided, he allows the blade to re-enter its sheath, and withdraws the instrument closed. In this manner the internal incision is almost transverse, and forms a very acute angle with the external incision; but this angle is easily effaced by pressure with the finger, and opposes no obstacle to extraction of the stone. Boyer never opened any artery that caused considerable hemorrhage, and the rectum is not at all endangered.*

* In England the knife seems now to be generally preferred to the lithotome caché, and cutting gorget; and the lateral operation, as usually performed, so nearly resembles that of Cheselden, that it is commonly called his proceeding. We extract the following from Mr. Fergusson's *Pract. Surgery*, p. 567.

"With some slight modifications, the following is a description of the proceeding, and such as I should recommend:—Every care being taken, as in all other operations, whether capital or not, that the patient is in as favourable a condition as circumstances will permit, the perineum should be shaved; a clyster of warm water should be administered about an hour before, and he should be desired to retain his urine until after the operation. Everything being prepared, the first step is to introduce the staff, which should be as large as the urethra will admit with ease, and having the groove presented a little to the left side of the urethra. This being slowly and cautiously done, as with the catheter, the instrument should be made to strike the stone, and should then be given in charge to an assistant." ("It is hooked against the symphysis and entrusted to an assistant, with directions to maintain the position steadily from first to last, neither to turn it so as to bulge in the perineum, nor to depress the handle as the knife enters the bladder; the surgeon's left hand is thus left at liberty to guide the knife, and guard important parts from danger." Liston's *Op. Surg.* p. 504.) Next, the patient should be secured in the manner described. "Then the surgeon should seat himself in front of the perineum, having previously arranged with an assistant about having the instruments handed to him, or having already arranged them properly on a chair at his side; now it may be well to pass the fore-finger of the left hand, well oiled, into the rectum, to ascertain the size of the prostate (if that has not been previously done), and also the depth of this organ from the surface; next, having withdrawn his finger, he should trace the course of the rami of the pubis and ischium on the left side, ascertain the position of the tuberosity of the latter bone on each side, and, having scanned the whole surface, he should proceed to use the knife, which he should hold much in the manner of a common bistoury. The point should be entered about one inch and three fourths in front of the anus, about a line's breadth left of the raphe, pushed through the skin, and carried by a kind of sawing motion down to the left side of the perineum, about an inch beyond the anus, the middle of the incision being at equal distances from the latter part and the tuberosity." ("The knife is then entered freely into the perineum, about an inch more or less behind the scrotum, and is made to cut downwards and outwards through the skin and the superficial fascia, in a line about midway betwixt the tuberosity of the ischium and the anus, and, beyond that orifice, towards the sacro-ischiatic ligament." Liston.) "Next, the blade should be run along the surface of the exposed cellular tissue; and then the point of the forefinger of the left hand should be thrust into the wound a little in front of the anus, so as to penetrate between the accelerator urinæ muscle and the erector—the knife being applied to any part which offers resistance; now with a little force the finger can be placed upon the membranous portion of the urethra, and the groove in the staff, and the blade, with the flat surfaces nearly horizontal, should be carried along above the finger, made to perforate the urethra about three lines in front of the prostate, and then be slid along the groove until it has entered the bladder, having slit open the side of the urethra and notched the margin of the prostate in its course. In withdrawing the knife, if the stone is supposed to be one of considerable magnitude, the blade should be kept a little out of the groove, so as to increase the incision of the prostate. The forefinger of the left hand should next be

III. BILATERAL LITHOTOMY. *Proceeding of Dupuytren.*—The instruments preferred by Dupuytren are:—1. A sound lighter than the ordinary sound, sloped off at the ends of its groove, and expanded at the place where it is most curved in the length of two inches, the better to distend the urethra, and terminated by an oblong expansion without any cul-de-sac of the groove. 2. A double-edged bistoury fixed in a handle, and sharp on each edge for about one-third of an inch starting from its point. 3. A double lithotome, the two blades of which are opened by one handle, and, by means of a peculiar mechanism, separate in a curved direction, so as to divide the prostate on each side in its oblique diameters. The opening of these blades varies from half an inch to nearly two inches.

The patient being placed as usual, the catheter is introduced into the bladder, and confided to an assistant, who maintains it in a perfectly vertical position. The surgeon with his left hand extends the integuments of the perineum, and with his right hand, armed with the double-edged knife, he makes a semicircular incision commencing on the right between the anus and ischium, and terminating on the left at the corresponding point; passing half an inch in front of the anus, the anterior part of which it circumscribes. The instrument divides successively the subcutaneous cellular tissue, superficial perineal fascia, and the anterior part of the sphincter externus. The commencement of the membranous portion of the urethra being laid bare, the nail of the left index-finger feels through the inferior wall of the canal the groove in the catheter, and guides to it the point of the bistoury. It is of consequence that, during all this first part of the operations, the finger depress the inferior part of the wound, protect it, and keep the rectum away from the cutting instrument.

After having opened the urethra to the extent of about one-third of

slipped slowly into the bladder along the staff, and in such a manner as to cause dilatation of the surrounding textures, and its point should be moved about in search of the stone; which, being found, should be retained in a position near the neck of the viscus; then the assistant should be desired to remove the staff, and the surgeon should introduce the forceps along the upper surface of the finger, slowly withdrawing the latter as the former makes progress: their entrance will be denoted by a gush of urine, at which instant the blades should be expanded, and now, in all probability, will be closed upon the stone; extraction should then be effected by a slow zigzag movement; and, this being done, the operation is completed."

There are several variations in the manner of performing the operation, and the instruments used; amongst them we may mention the following:—Most surgeons direct the assistant to cause the staff to project a little on the left side of the perineum; and, when about to pass the knife into the bladder, they take the handle of the staff in their own left hand, and bring it down to the horizontal position. Sir B. Brodie uses a beaked knife; or, if the stone is large, a double edged knife with a beak in the centre, so as to divide both sides of the prostate. Mr. Key prefers a straight staff. The late Mr. Martineau, of Norwich, after having divided the membranous and prostatic portions of the urethra, gently introduced a gorget with a bluntish edge; the opening of the bladder was thus enlarged smoothly, and to a sufficient extent. It is still employed very successfully by his successor, Mr. Dalrymple. (Liston, p. 507.) Lastly, there is the method which was employed by Cheselden, and which is still practiced by a very experienced and successful lithotomist, Mr. C. Mayo of Winchester. In this method the operator, after making the usual external incisions, "cuts into the side of the prostate as far back as he can reach, and brings out the knife along the groove of the staff into the membranous part of the urethra," thus making the incision into the neck of the bladder from behind forwards, instead of from before backwards, as in the other varieties (Druit, p. 488).

an inch, the nail of the left index-finger placed in the superior part of the wound, serves to guide the lithotome, which, held in the right hand, the thumb beneath, and the two first fingers above, is presented to the catheter, the convexity of its curve looking downwards towards the anus.

The contact of the instruments being well recognized, the surgeon takes the handle of the sound in his left hand, and, elevating the instrument under the symphysis pubis, slides the lithotome along its groove into the bladder. This done, the staff is withdrawn; the lithotome should then be turned so as to present its concavity to the anus. Lastly, the surgeon, grasping it in the usual manner, takes the lever in his right hand, depresses it to the handle, and withdraws the unsheathed instrument, not horizontally, but inclining it progressively downwards until the blades are entirely brought out.

The index-finger is then introduced into the wound, to measure the extent of the incisions made, and serves as a guide for the forceps. If the opening made in the neck of the bladder and prostate seems insufficient, it would be easy to enlarge it on each side with a straight button-pointed bistoury; guided on the index-finger. Without doubt the first incision might be made with the ordinary lithotome caché, and the second with a probe-pointed bistoury; or you might use the bistoury for each, and the proceeding would be simplified; but it would be at the expense of the security and rapidity of the operation.

We would only add that, as Dupuytren does not make his blades diverge at farthest more than two inches, you might use a double lithotome, the blades of which diverge parallelly. The prostate might well bear this incision across without its circumference being passed. In this way the complication of the instrument would be in some measure diminished.

IV. QUADRILATERAL LITHOTOMY. *Proceeding of M. Vidal de Cassis.*—The incision of the external part is the same as for the bilateral operation. M. Vidal proposes to incise the prostate in its four oblique radii. For this purpose you may use the button-pointed bistoury alone, or the double lithotome of Dupuytren for the inferior incisions, and the bistoury for the superior; or, lastly, a lithotome with four blades, proposed by M. Vidal and made by M. Colombat, but of which the former did not perceive the inconvenience of its not being able to open in the bladder, in case it is occupied by a large calculus.

Moreover, it is not to be presumed that any surgeon commences by performing these four incisions on the prostate. If one does not suffice, a second is made; if two are still not enough, three or four may be made. But there are no more rules: the bistoury goes at random, and there is nothing to warn whether the boundaries of the prostate are reached; which boundaries it is essential to respect in the method by numerous incisions. I shall return to this point in the appreciation of all the methods of lithotomy.

(2.) *Recto-vesical Lithotomy.*

Surgical Anatomy.—Starting from the end of the colon, the rectum passes at first rather obliquely from left to right, and from above

downwards (see Fig. 22); then it bends from behind forwards under the bladder as far as the prostate; lastly, from thence to the anus it passes downwards and backwards, so that it may be considered as formed of three parts. The first, extended from the end of the sigmoid flexure to where the intestine leaves the peritoneum, constitutes more than half its length; flexible and free, its relations are not of much importance. The middle portion, included between the two bends of the intestine, is, according to Sanson, three inches in length; but this is very exaggerated. It passes from above downwards and from behind forwards, and is slightly curved in the same direction. It corresponds constantly—1. Behind, to the inferior part of the sacrum, to the coccyx and floor formed by the ischio-coxygeal muscles. 2. Below to the base of the bladder, from which it is separated on the outside, and below by the vesiculæ seminales and vasa differentia, and lower down by the prostate. 3. At the sides to an abundant cellular tissue. It is deprived of peritoneum, excepting sometimes at its upper part, when the bladder is much contracted. Its muscular coat is more thick, and better furnished, especially with longitudinal fibres. Lastly, on all sides it is surrounded by a loose and abundant cellular tissue (excepting under the prostate, where it is more compact), which allows it numerous variations in size. The third portion, comprised between the prostate and anus, is, according to Sanson, one inch and a half long. This is also exaggerated by one-half. Sanson probably measured the rectum dissected out and detached from the surrounding parts. I have already shown how fallacious this method is on the urethra. The last portion is then, at the extreme, one inch and one-fifth long; it descends obliquely backwards. Its superior part is surrounded on all sides by an abundant cellular tissue, excepting in front, where it corresponds to the prostate. Lower down it is enveloped by the sphincters. Its structure differs from that of the others. In fact, the longitudinal fibres cease suddenly, and there are only circular fibres, the thickness of which increases as the intestine descends; and which furnish two elongations under the skin, one of which, the longest, passes to the bulb, the other to the coccyx.

The base of the bladder, divided on the outside into three surfaces, by the vesiculæ seminales, corresponds by its lateral surfaces to an abundant fatty cellular tissue, which separates them from the levator ani; the middle portion triangular, with its base superiorly, bounded by the peritoneum, is immediately applied on the rectum, the curve of which it follows to the prostate. There it separates from it slightly and raises a little forwards to reach the urethra, which is the continuation of it.

We have pointed out the direction of the urethra in the article on catheterism. It will suffice to add that, on leaving the prostate, it separates from the intestine, forming an angle open towards the perineum. The urethra in front, the skin and sphincter below, and the rectum behind, bound a triangular space, the base of which is at the raphé, the summit at the prostate, and which is filled by cellulo-fatty tissue.

Starting from the rectum, along the median line of the body, we find

in front of the intestine—first, in front of its middle portion, some loose cellular tissue, a network of veins, and the inferior wall of the bladder. Secondly, lower down the prostate, traversed by the ejaculatory ducts. Thirdly, in front of the inferior portion, the mucous membrane, strengthened by the sphincter; the triangular space pointed out, and altogether in front, the bulb of the urethra, and the posterior part of the corpora cavernosa, but nowhere any remarkable vessel (Sanson).

There are two principal methods, each invented by Sanson; the first, which consisted in opening the bladder above the prostate, has been since given up by the author himself; and for the second, Sanson has adopted, instead of his former proceeding, that which we are about to describe.

Proceeding of Vacca Berlinghieri.—The subject being placed as for perineal lithotomy, the staff is introduced into the bladder, and an assistant keeps it in a vertical direction, so that its groove may exactly correspond to the median line. The index-finger of the left hand should be introduced into the rectum, with its palmar surface forwards. On this surface the blade of a common straight bistoury is passed to a depth of three-quarters of an inch only, beyond the border of the anus; then the handle being depressed, its point is pushed forwards, through the parietes of the intestine, at the height mentioned; its edge, being then directed upwards, divides at the same time the sphincter ani, the inferior part of the rectum, the perineum from the anus to the bulb, and the cellular triangle that separates these two parts. The inferior portion of the prostate may then be felt through the wound, and in front of it the muscular portion of the urethra and the staff. The nail of the index-finger then serves as in the lateral operation, to find the groove in the staff, and guide into it the point of the knife. The staff is then elevated, and the bistoury slid along it into the bladder. As soon as it has entered the neck of the bladder, the surgeon should depress it so as to divide the prostate downwards and backwards, on the median line, without passing beyond its circumference, and especially without again touching the incision of the rectum. In this way the wound presents a passage very oblique from above downwards, and slightly from before backwards. The intestine is injured as little as possible: at each effort of excretion the mucous membrane is depressed over the wound, and the latter is under the most favourable circumstances to heal without fear of fistula. The only parts affected are the rectum at its inferior part, the sphincter ani, the prostatic portion of the urethra, and the prostate itself; that is to say, you divide the parts that were distended, or even torn, in the apparatus major.

(3.) *Hypogastric Lithotomy (High Operation).*

Anatomy.—The peritoneum, which lines the abdominal parietes, is applied on the internal surface of the muscles, and on the fascia so much the more loosely the lower it is examined. Arrived near the pubis, it bends backwards to reach the posterior surface of the bladder, being separated from its anterior surface by the urachus. Between this fold of the peritoneum, and the superior border of the pubis, is a

free space, varying according as the bladder, full or empty, rises higher or descends lower. At this point the anterior surface of this viscera is separated from the pubis and linea alba by adipose tissue only. On incising along the linea alba, you have only to divide the skin, fascia superficialis, and anterior aponeurosis of the recti muscles to reach the adipose tissue, and, if you divide it, the peritoneum above, and the bladder below.

Proceeding of Amussat.—The patient is laid horizontally on a table, covered with a mattress, but in such a way that his pelvis may be the most elevated part; the hair of the pubis should be previously shaved off. The operator, standing on the left side, introduces a sound into the bladder, to again recognize the stone, and injects through this sound a glass or two of warm water; after which he withdraws it, and an intelligent assistant places his finger on the meatus to prevent the return of the injection, taking care to press the penis but lightly. The operator then changes to the right side of the patient, seeks to recognize the edge of the symphysis, and with his eyes fixed on the point to be divided by the bistoury, makes an incision which divides the skin and fat to the linea alba from above downwards, in the extent of three fingers' breadths, above, and a little in front of the symphysis. The index-finger seeks the linea alba at the bottom of the incision. As soon as it is recognized, he incises it downwards to the extent of one inch at most; more deeply, a strong aponeurosis is found. In order to open it without injuring the peritoneum, the edge of the bistoury is turned up, and its point is gently passed in from before backwards, immediately above the symphysis pubis. When the resistance is overcome, the incision is prolonged upwards, and then an attempt is made to introduce the finger. If it is tight, free it gently, right and left, and downwards, avoiding injuring the os pubis.

When the index-finger penetrates easily, it soon meets the summit of the bladder; this finger should then be directed downwards, between the symphysis and bladder, without deviating, and without penetrating too deeply, the nail turned forwards, and the pulp of the finger backwards. Now the operator introduces the right index-finger into the rectum, and, by elevating the base of the bladder, assures himself that it is this organ that he holds between these two fingers. Then he insinuates the blade of a bistoury flat between his finger and the bones: having reached the part where he wishes to plunge it in, he slightly curves his finger backwards and upwards, and boldly pushes in the bistoury, from above downwards, and from before backwards; if its blade is wide, there is no need of extending the incision. The left index-finger is immediately plunged into the opening directly downwards, with a boring movement. The finger closes the incision, and hinders the liquid from coming out; and you may explore all the cavity of the bladder. Then the finger is bent as a crochet, and, the bladder being drawn up, the opening is enlarged by traction only. The liquid escapes in abundance, and the tenettes should be immediately introduced; the finger serves at the same time to guide them, to push the stone into them, and to see, after its extraction, whether the bladder contains any more. After extraction is finished, the end

of a large curved canula is introduced into the bladder to direct the urine to the outside. The wound is re-united over it by first intention, and the threads that retain the canula should be fixed with adhesive plasters.

Proceeding of Baudens.—He does not inject into the bladder; before taking up his bistoury, he marks with the nail the situation of the symphysis, and the extent to which the incision should be limited superiorly. The skin and subcutaneous tissue being divided, he recognizes the linea alba, and incises some lines outside the aponeurosis that covers the rectus muscle to the same extent as the skin; then resigning the bistoury, he tears the cellular tissue that divides the two recti muscles with the finger, plunges the left index-finger behind the symphysis pubis, penetrates to the neck of the bladder; and then curving back his finger as a crochet, and scraping with his nail the anterior surface of the bladder, from below upwards, he brings upwards the fold of the peritoneum, in such a way, that the bistoury conducted by the right hand, and guided on the nail of the left indicator, is plunged into the bladder without risk of wounding the abdominal serous membrane. The remainder as in the proceeding of Amussat.

The second proceeding is the simplest and safest; but, if the bladder is empty, there would be some difficulty in drawing back the peritoneum to a sufficient height. Injection should then be previously performed.

M. Baudens also reasonably advises freely dividing the skin downwards, lest it should recede before the bistoury, and the subjacent cellular tissue be cut a little lower than it, and a kind of pouch (“nid de pigeon”) result, through which the urine could infiltrate into the scrotum.

M. Belmas proposes a catheter containing a sharp stylet (“sonde a dard;”) he introduces it through the urethra; its use is to extend the anterior wall of the bladder, and consequently push back the peritoneum upwards, and to serve as a guide for the bistoury. This sound complicates the proceeding of operation without making it more safe.

Appreciation.—It is very difficult to make an absolute choice between the different methods of lithotomy, or even to point out the cases in which one should be preferred to another, so much difference of opinion still exists on this point. When the calculus is more than about two inches in diameter, the high operation is generally thought necessary. When the calculus is smaller, most surgeons still prefer perineal lithotomy by the lateral (“latéralisée”) or bilateral method.

After much study and comparison, I have come to the conclusion that but very little influence on the result of the operations, as regards the life or death of the patients, is to be attributed to the proceeding of operation. This influence only exists inasmuch as the proceedings expose, more or less, to pain and loss of blood, and, especially, to inflammation. It is the pain and inflammation that kill the patients, after lithotomy: and the most powerful causes of these assuredly are the

dragging, tearing, and bruising of the tissues; accidents, inevitable in all the proceedings of perineal lithotomy, when the calculus surpasses the most moderate proportions, and which, when the patient does not sink under them, cause the most serious infirmities. I have seen several patients, who had been cut by the most skilful operators, the limits of the prostate being respected, who had lost all faculty of having erections and ejaculating. I saw one who, in addition to the absolute loss of his genital functions, could not retain his urine, and was obliged to keep his penis constantly squeezed by a constrictor. Double, triple, and quadruple incisions, do not definitely augment the extent or elasticity of the external layers of the prostate; and, by dividing it still more, they seem to expose it more also to be bruised in the passage of the calculus.

In my opinion, there is only one way of rendering perineal lithotomy less dangerous, at least as regards the operation itself; it consists in following a precept entirely opposed to that which is generally laid down, viz. in *dividing the prostate freely on one side beyond its limits*; cutting the neck of the bladder, and the cellular tissue, if the size of the stone necessitates it; in a word, in making so free a passage for the stone that the wound may remain an incision, and not be complicated by contusions and lacerations.* As for the external

* It will be seen that M. Malgaigne, boldly and decidedly, lays it down as a precept, that the prostate should be freely divided beyond its limits or circumference. As this, however, is a very disputed point, and a question of the highest importance on account of the serious nature of the accidents attributed to each method by its opponents, and the great respect due to the high names and authorities ranged on either side, we think it necessary to support M. Malgaigne's precept by quoting the words of those who agree with him, at the same time that we mention the authorities opposed to it and their objections.

The question is—To what extent should the prostate be divided? Should the incision be limited to a few lines or to within its fibrous envelope? or should it be freely divided beyond this envelope, as advised by M. Malgaigne?

The reason for limiting the incision, and not cutting beyond the fibrous envelope of the prostate, is, in Mr. Liston's words, "to avoid all interference with the reflection of the ilio-vesical fascia from the sides of the pelvic cavity over the base of the gland and side of the bladder. If this natural boundary betwixt the external and internal cellular tissue is broken up, there is scarcely a possibility of preventing infiltration of urine, which must almost certainly prove fatal. The prostate and other parts around the neck of the bladder are very elastic and yielding, so that without much solution of their continuity, and without the least laceration, the opening can be so dilated as to admit the fore-finger readily; through the same wound the forceps can be introduced upon this as a guide; and they can also be removed along with a stone of considerable dimensions, say from three to five inches in circumference in one direction, and from four to six in the largest."—p. 506.

Velpeau's objection.—We translate the following from M. Velpeau's *Anatomie Chirurgicale*, tom. ii. p. 242:—"The first rule consists in not prolonging, under any circumstances, the division of the prostate beyond its circumference. The fact is, if this rule is not attended to, the neck of the bladder is more or less divided, the lips of the wound being no longer maintained by the solid tissues that surround the gland, nor by a more or less thick band of its envelope, separate in such a way that the urine easily escapes, and is effused in the surrounding parts. Then two things are to be feared: 1. Urinary fistula; 2. Inflammation of the cellular tissue that surrounds the neck of the bladder, which inflammation spreads to the cellular layer between the rectum and prostate, the prostate and pubis, the perineal fascia and the pelvic fascia, and is prolonged to the peritoneum and bladder. There is another reason why the surgeon should be on his guard: it is, that abnormal arteries of considerable size have been met with, surrounding the prostate. Haller mentions a case; Burns and Winslow mention three cases; Harrison three others; Tiedemann and Meckel speak of it as very common; I have myself seen it twice."

wound, it seems to me that it might be enlarged advantageously, *if* required, by encroaching, more or less, on the right side of the raphe, to obviate the necessity of approaching too near the sciatic tuberosity.

Scarpa says, "If, in order to avoid distending the parts to the extent of eight lines, the base of the prostate gland, together with the orifice of the bladder and a part of its fundus, be divided to a depth equivalent to it, the event would necessarily be an effusion of urine into the cellular membrane between the rectum and bladder, and consequently suppuration, gangrene, fistulæ, and other serious evils."—Memoir on the Cutting Gorget of Hawkins, &c., translated by Wishart, p. 485.

The reasons for preferring free incision to a limited incision and dilatation, are given above by M. Malgaigne; to them we may add the opinions and experience of Mr. S. Cooper, as stated in his *Surgical Dictionary*. "I have seen the lateral operation performed an immense number of times with beaked knives, the lithotome caché, various kinds of gorgets, or common scalpels. Generally speaking, those surgeons who made only a small incision into the bladder and kept their patients a long while on the operating-table ere they succeeded in getting out the stone by the repeated and forcible use of the forceps, had the mortification to see very few of their patients recover; a large proportion of them being carried off by peritonitis on the third or fourth day after the operation. On the contrary, when the incision was ample and direct, so that the calculus could be easily and gently removed, the patients were almost always saved." The greater number of lithotomists who have particularly distinguished themselves by their unparalleled success, as Frère Jacques, Cheselden, Côme, Mr. Martineau, Dr. Souberbeille, &c., made a free incision into the bladder. "Are we then (in consequence of the objections raised against it) to conclude that the plan of making a free and direct incision into the bladder ought to be abandoned? Must we forget that it is this method which has answered so well in the hands of Cheselden, and the several renowned lithotomists already enumerated; and must we believe that the advice delivered upon this point by Bertrandi, Desault, by Mr. J. Bell, and all the best modern surgeons in this country, is founded upon a capricious partiality to the free use of cutting instruments." "Are we not justified in inferring that the advocates for a small opening are promulgating the worst advice which can be offered to the practitioner?"—pp. 840, 841.

"With respect to the degree of importance which ought to be attached to the fear of effusion of urine between the bladder and rectum, gangrene, fistulæ, &c., I can only say, that they are inconveniences which are not commonly observed after lithotomy in this country. As for the extravasation of urine and sloughing, I shall merely remark that, although there cannot be a doubt of their occasional occurrence, they have not taken place after any of the numerous operations with the results of which I have been acquainted. All these facts and considerations, therefore, incline me to doubt whether the apprehension of the effusion of urine, fistulæ, &c., be sufficiently serious and well-founded to make it advisable for surgeons to relinquish the plan of making a complete division of the prostate and neck of the bladder in the operation of lithotomy. Indeed, when they do happen, I believe they proceed from a totally different cause, viz. from the incision of the skin being too small and too high up, and from the axis of the internal part of the incision not corresponding with that of the external wound. Hence the urine does not readily find its way outward, and some of it passes into the neighbouring cellular membrane."—p. 842.

Amongst those who prefer the limited incision are Callisen and Scarpa. The latter contends that two or three lines of the substance of the base of the gland should be left untouched.

Sir B. Brodie—"It is important, therefore, that we should avoid carrying the incision beyond the boundaries of the prostate into this loose cellular membrane."—Brodie on Diseases of the Urinary Organs, p. 303.

Mr. Fergusson, who says in his description, "having notched the margin of the prostate;" but further on he remarks, "there should be no hesitation in cutting any part of the gland which seems to offer great resistance."—p. 569—573.

Mr. Liston—"But the internal incision must be very limited indeed; it should certainly not extend beyond six or seven lines from the urethra, outwards and downwards; for the less that is cut the greater will be the patient's safety."—p. 506.

Mr. Bransby B. Cooper, who directs "that no larger opening should be made with the knife than will just admit the fore-finger of the left hand;" and who has informed me that he has only lost one case in his last twenty-nine.

M. Velpeau—"The surgeon should endeavour to cut the prostate to as great an extent as possible without completely passing its circumference."—Anat. Chir. tom. ii. p. 244.

An external incision, bilateral if necessary, and a unilateral incision of the prostate, but with all the necessary extent, is the proceeding to which I give the preference, and which has already been adopted with success by several skilful lithotomists. See my Surgical Anatomy.

SECTION V.—LITHOTRITY.

Lithotrity, though proposed but very lately, has been already so diversified, as to its instruments and proceedings, that we are almost confused by their variety. But the greatest part of these modifications affecting only the purely mechanical part, we shall confine ourselves to the establishment of the rules for applying the three principal methods—drilling, crushing, and percussing.

(1.) *Lithotrity by Drilling. (Usure progressive.)*

The instruments for drilling the stone are generally reduced to the following.—1. A straight external canula, which serves for a sheath, and should never be more than four lines and a half in diameter.—2. An internal canula or, "*litholabe*," terminated by a forceps with two, three, four, six, eight, or eleven branches intended for seizing the stone.—3. A central rod of steel to act on the calculus, the external extremity of which is differently shaped; sometimes as a file to fritter away the stone from without inwards, as the *lithorineur* of Meyrieu—or it is armed with teeth to perforate the calculus, as the "*lithotriteurs*," or "*forets*," of M. Civiale; or lastly, cleft drills, which separate so as to first perforate the stone and then scoop it out, as the *fraisè à développement*—*à virgules*—*l'évideur à forceps*, &c. All these instruments act freely one inside the other. Moreover the external canula is furnished with a screw, which can fix it in a solid manner to the internal canula. The latter is in addition marked on its outside with the divisions of the *mètre*, in order that it may be judged how far its branches are protruded beyond the external canula, and at the same time how far apart they are separated. All this apparatus is supported outside; sometimes by a handle like that of a wimble, which serves at the same time to turn the lithotriteur; more usually by a prop, secured by the hands of an assistant; or, again, by the metallic support, a kind of vice fixed to the patient's bed. Lastly, some operators use a special bed, to which the support remains fixed. In these last cases the *lithotriteur* is furnished on its outside with a pulley, on which plays the cord of a bow, which communicates to it quick and energetic movements of rotation.

Operation.—Before proceeding to lithotrity, the urethra should be dilated and accustomed to the presence of a foreign body. For this purpose flexible sounds are introduced each day for ten or twelve minutes, their size being progressively increased. For instance, begin with a sound two lines in diameter, and end with one four, or at farthest four and a half. A sufficient dilatation may generally be obtained in eight days.

Everything being prepared for the operation, place the patient on his back at the edge of his bed, with his pelvis supported by a rather

hard pillow, his feet resting on footstools, and his head moderately flexed on his breast. This elevation of the pelvis is intended to render inferior the posterior wall of the bladder, in order that the stone may fall there of its own accord, and be more easily seized. Then an ordinary catheter is introduced, and by means of a syringe a quantity of warm water, or a mucilaginous decoction proportioned to the capacity of the bladder is injected. As soon as the patient feels an urgent desire to urinate, enough has been injected. The catheter should now be withdrawn, and the instrument, closed exactly and carefully oiled, is immediately introduced, its beak formed by the reunion of the branches of the *litholabe* being made even with suet, so as to represent a blunt rounded olive. It is introduced in the manner described for catheterism with the straight sound. The patient should then be raised almost in a sitting posture, and, when the instrument is introduced, be again placed in the indicated position. The operator should now place himself between the thighs of the patient.

The first care of the surgeon should be to seek the stone. For this purpose he moves the beak of the instrument, still closed—1. From before backwards, over the middle portion of the base and posterior wall of the bladder—2. From behind forwards, as if to complete the circle, returning by the right side or by the left—3. From before backwards a second time, returning by the opposite side to come back over the middle, where the stone may have fallen—4. Lastly, transversely, so as to leave no point of the floor of the bladder untouched. You may, as required, vary the position of the patient by elevating his pelvis, and inclining it to the right or left; lastly, as a last resource, M. Civiale recommends unfolding the branches of the *litholabe* to explore the bladder in several points at once.

To open its branches the operator takes the extremity of the *litholabe* in his right hand, and holds it immovable, whilst with the left hand he brings back towards himself the external canula, as if he wished to withdraw it from the urethra; the litholabe, thus unfolded, does not move at all forwards, and does not endanger the bladder. The calculus must then be again found and seized, a manœuvre that is often difficult, and requires great care and judgment. In general with a three-branched forceps, two of its branches on the same level should be directed downwards; and with the litholabes, with numerous branches, the two branches that offer the greatest interval between them.

If, for instance, on depressing the forceps it falls on the calculus, producing the sensation of a double shock, the calculus is under its two branches, and behind the prostate. If there is but one simple shock, and one of the branches descends lower than the other, you will find the stone on the most elevated side. If it is in front, and the two branches pushed alternately, not together, equally feel it, it corresponds to the interval between them. A slight transverse movement to the right, and then to the left, will show whether the stone is in the interior of the *litholabe*, nearer one branch than the other, or in the middle. You will see that these indications may be varied infinitely; and that, with a little practice, the position of the stone may

be readily made out. The calculus being now placed between the two inferior branches, again take hold of the free end of the litholabe, which you raise a little with the right hand, that its branches may not cease to rest on the base of the bladder, and with the hand push on them the external canula which closes them; but, before you exactly fix them, it is well to move the lithotriteur backwards and forwards, to assure yourself that the stone is well seized, and that the instrument can easily act on it; then, and not till then, push the external canula as far forwards as possible on the litholabe, and fix it immovably by means of the screw.

Then fix to the end of the instrument the apparatus for supporting it, whether an assistant placed between the legs, or at the right of the patient, hold it, or it is fitted to the bed itself. The operator then passes the cord of the bow round the pulley, and placing himself a little to the right, firmly grasps the instrument with his left hand, between the penis and the support, whilst, with his right, he moves the bow. On commencing the perforation, it must be moved gently to avoid shocks; but, afterwards, you may use more strength and rapidity at the same time, and incline the effort of the bow forwards, to combine with its rotation, pressure on the stone. When the stone is very hard, which is known by the sharpness of the sound, and the slight progress of the lithotriteur, a spiral spring is added to the instrument to push the lithotriteur forwards.

Formerly, the drilling was continued during ten minutes, but latterly M. Civale has laid down the important precept of short sittings ("séances"), and the instrument should not in general remain in the bladder more than one or two minutes.

To withdraw the instrument, first loosen the screw, open the forceps, and push the stone out of it by means of the lithotriteur, then withdraw the latter first, and the branches may be closed by withdrawing the forceps towards yourself. It often happens that some fragments of the stone are brought away with the forceps; if they are so large as to render the withdrawal of the instrument painful, you should crush them by pushing the head of the lithotriteur against the branches of the forceps.

The first urine passed by the patient is usually tinged with blood. He should take a bath immediately after the operation, and be ordered repose, and a mild diet; on from the third to the fifth day, you may begin again; the number of sittings depends on the size of the stone and the condition of the patient.

When the simple *lithotriteur* or *foret* is used, you must, at each fresh sitting, assure yourself, by means of the lithotriteur, that the stone is not seized in the same position; if it is, you must turn it, by slightly separating the branches of the forceps, and slightly rotating the lithotriteur on the stone.

If the *lithorineur* is used, this precaution is not at all necessary; and with the "*avideur*," when several sittings are necessary, it is even more useful, though not indispensably necessary, to seize the calculus exactly as it was first held.

When at length the stone is divided into fragments, sometimes too

large to be expelled, crush them either by closing the branches of the forceps on them, or by pressing the lithotriteur on them; and before terminating the treatment, you should well assure yourself, by one or two final explorations, that no fragment still remains in the bladder.

We omit all that which has reference to the mode of action of the instrument; it is the purely mechanical part of the art, which cannot be clearly demonstrated by descriptions without figures, and which can be better understood by manœuvring the instrument on a table. Moreover, it is a general rule never to use complicated instruments without being familiar with their mode of action.

(2.) *Lithotrity by Crushing.*

M. Amussat, in 1822, invented a forceps with two indented branches which seized and crushed the stone, but could only be employed for very small calculi. The "*brise-coque*" of M. Heurteloup, made after an analogous plan, is liable to the same reproach. The instrument of M. Jacobson has had more celebrity.

Proceeding of Jacobson.—His instrument is composed of a solid silver canula, shaped almost as a female catheter. In this canula is placed a steel shank, passing beyond it at the side next the bladder, and continuing its curve. This shank is split, in its entire length, in two, the half corresponding to its concavity is fixed, the other, forming its convexity, is movable. This movable portion is articulated to the extremity of the fixed portion; and, in addition, presents three other joints in its length.

The instrument, closed, is introduced as a common sound. When it has penetrated into the bladder, and recognized the calculus, the operator pushes forwards the movable branch, which separates from the fixed branch, and is depressed into the bladder; and, by means of its articulations, figures a kind of loop, which he should try to slip under the stone. The calculus being embraced by this loop, he pulls the handle of the shank towards himself, which causes the stone to be strongly squeezed against the fixed portion. Then a screw, with a triple lever, which takes its purchase against the edge of the canula itself, is put in play, and, by forcibly bringing the movable branch outwards, causes the foreign body it compresses to be crushed.

Lastly, in order to obtain a more powerful and sure-crushing instrument, we have advised the application of a screw to the *percuteur* of M. Heurteloup, which it remains for us to describe. It is the one that has had most success.

(3.) *Lithotrity by Percussion.*

Proceeding of M. Heurteloup.—The instruments necessary are:—First, the *percuteur courbe à marteau*, a steel shank, fifteen inches in length, formed like a large sound, straight in the greatest part of its extent; but with its extremity curved in the quarter of a circle of an inch, or an inch and a half radius. This shank is divided into two parts; the one corresponding to its convexity is fixed; that is to say, it is fastened to a square piece of steel, forming a handle, and which is placed in a metallic support, attached to the bed on which

the operation is performed: the other, corresponding to the concavity, is movable; that is to say, it can be advanced or retired, so as to separate or approximate, one to the other, the two portions of the curve; in the same way as the foot-measure of bootmakers. Second, a metallic hammer of suitable size. Third, a bed called a rectangle, to the edge of which is fastened the support which M. Heurteloup calls his fixed point.

The closed instrument being introduced into the bladder, in the same manner as a common curved sound, by withdrawing the movable branch, the two curved portions are separated, and a sort of open forceps obtained with which the calculus is sought. When it is found and seized, the movable branch is strongly pushed, to firmly squeeze it between the two portions of the curve, which, moreover, are indented to better hold it; then the fixed branch being placed, and retained in the fixed point, by means of its handle, the movable branch is struck with the hammer; the percussion is transmitted without any loss to the stone, which soon breaks under this powerful effort. The application of this instrument does not in general occupy more than five minutes, and from five to eight sittings suffice in almost all cases.

Appreciation.—Percussion is certainly the most expeditious method, and, moreover, the construction of M. Heurteloup's instrument is such as to answer all objections. The employment of the rectangle bed and metallic fixed point is not as indispensable as the inventor supposed; and the percuteur has been greatly improved by the addition of the screw mentioned by M. Heurteloup, improved by Ségalas, and still more recently by MM. Civiale and Leroy d'Etiolle. Modifications which make it at the same time an instrument of pressure and percussion. It seems to us to deserve preference.

The instrument of Jacobson is almost abandoned. The forceps, with three branches, and the perforators successfully used by M. Civiale, serve also, sometimes, as instruments for compression, either for small calculi or for fragments, by crushing these portions of stone against the branches with the head of the "foret." It has more advantage than is generally supposed, especially in skilful hands. At the same time, M. Civiale admits the employment of the percuteur in some cases; and the majority of operators give it an absolute, and in our opinion, justly-merited preference.

CHAPTER X.

OPERATIONS ON THE GENITO-URINARY ORGANS OF THE FEMALE.

WE shall divide these operations into three classes. First, those performed on the urinary organs. Second, those performed on the genital organs, properly so called; and third, obstetric operations (*opérations tocologiques*).

SECTION I.—OPERATIONS PERFORMED ON THE URINARY ORGANS.

(1.) *Catheterism.*

Anatomy.—The urethra, from one inch to an inch and a quarter in length, and lying on the vagina, is slightly curved, being concave upwards. Its superior surface is about four lines from the symphysis pubis, in the normal condition. Its external orifice is situated at the anterior border of the vagina, at the union of the upper part of its circumference with the base of the vestibule. In women who have borne many children, in old age, and during utero-gestation, this orifice rises behind the pubis; so that it must be looked for in the upper and anterior part of the vagina, or even behind the symphysis; and care must be taken not to introduce the instrument into the vagina instead of the bladder.

Ordinary Proceeding.—The patient is laid on her back, with her pelvis raised, her thighs separated, and slightly flexed, and the parts uncovered; the surgeon, standing on the right side, places his left hand pronated on the groin, and separates the labia minora with the thumb and index-finger; and, with his right, takes the catheter as a pen, and presents its beak, the concavity upwards, at the orifice of the urethra; as soon as it has entered it should be depressed a little, to pass it under the symphysis, and then raised again, and pushed in the direction of the urethra, when it immediately enters the bladder. If the fundament and vulva seem too much buried, the sound should be passed under the corresponding ham; and in order to find the orifice of the meatus better, Velpeau advises to separate the nymphæ with the thumb and middle-finger, whilst the index raises the clitoris and vestibule.

Second Proceeding.—The catheter is passed without exposing the patient, the surgeon being guided by the touch only. To effect this, the clitoris being raised in the manner pointed out by Velpeau, the beak of the catheter is passed along the nail of the index-finger, and slid gently from above downwards on the median line on the vestibule, and thus almost inevitably glides into the urethra; or again, the catheter is brought from below upwards, its extremity resting on the middle-finger of the right hand, whilst the ring-finger feels successively the fourchette, the vaginal orifice, then the anterior column of the vagina, the termination of which, more or less expanded into the form of a tubercle, is immediately under the urethral orifice; arrived at this point, the ring-finger stops, and serves for a conductor to the catheter, which is glided on it. The meatus cannot be more than one or two lines off, and is almost always found after some manipulation.

The catheter may be passed on a woman seated on the edge of her bed. In this case the surgeon places himself between her legs, seated, or on one knee; especially if he does it without raising the clothes.

(2.) *Of Lithotomy.*

The rules for the hypogastric operation are the same in the male and female.

The proceedings peculiar to the female are divided into three methods, according as the urethra, the vestibule, or the vagina is cut.

I. VESTIBULAR LITHOTOMY.—We have already pointed out the relations of the urethra: we must add that, by depressing it the vestibule may be made above an inch in depth. Between this region and the bladder it is necessary to divide, first, the mucous membrane: second, the cellular tissue; third, the constrictor vagina; fourth, a dense elastic cellular tissue; fifth, the anterior ligaments of the bladder; sixth, the parietes of the bladder itself.

Operation. (Lisfranc.)—The woman is placed as for the operation of perineal lithotomy in the male: two assistants separate the labia majora and minora; the surgeon passes into the bladder an ordinary catheter, the convexity of which he directs upwards; its handle is confided to an assistant, who, pressing slightly on it from above downwards, depresses the urethra and vagina.

The surgeon explores with his finger the situation of the rami of the pubis, stretches the tissues with the left hand, and marks with the index and middle fingers the points where the incision should begin and end. Then with a straight bistoury, held as a pen, he makes a semi-lunar incision, with the convexity upwards, which commences on a level with the right side of the meatus urinarius, passes along the rami and symphysis pubis, at a distance of about a line, and terminates at a point diametrically opposite. The handle of the bistoury must be held lower than its point. The resisting tissues mentioned above are then cut layer by layer, and the cellular tissue is divided by the index-finger, which serves as a guide for the instrument: and, lastly, arrived at the bladder, either the bistoury is plunged into it, and it is divided transversely; or, introducing the left thumb in the vagina, and the index in the wound, a sufficient traction is made on the tissues they embrace to stretch the bladder and bring it slightly forward, and the incision is more sure and easy. Or the organ may be divided on the convexity of the catheter. As soon as the incision is made, the finger is introduced, and it is easy to enlarge it. The bladder may be incised perpendicularly or transversely. M. Lisfranc prefers the transverse incision.

II. URETHRAL LITHOTOMY.—It has been proposed to divide the urethra obliquely to the left, on a director introduced into it, in imitation of the lateral operation in the male; or to divide it on both sides at once (Louis). Fleurant has even proposed a double lithotome; but the following proceeding is generally preferred to all others.

Proceeding of Laurent Colot.—The patient being placed as usual, a director is introduced into the urethra, and its groove directed towards the symphysis pubis. The surgeon holds it immovable with the left hand; with the right he conducts on it a straight bistoury, and divides the anterior wall of the urethra and the neck of the bladder, proportionably to the presumed size of the stone; then the instruments are withdrawn, and the index-finger, introduced into the bladder, serves as a conductor to the forceps. This operation was described by Paré; it was renewed lately by M. Dubois. Dupuytren preferred,

to the bistoury and director, the lithotome caché of Côme, which is more sure and easy to manage.

III. VESICO-VAGINAL OPERATION.—The only proceeding that has been used is the incision of the vesico-vaginal septum, without touching the urethra; the danger of a consecutive fistula has caused it to be generally rejected.

Perhaps it might succeed better if the inferior wall of the urethra was incised to the neck of the bladder only, which would resemble the plan of Vacca-Berlinghieri for the recto-vesical operation.*

(3.) *Dilatation of the Urethra.*

It is performed for the extraction of foreign bodies and small calculi, and is effected in two ways—1. By the aid of a speculum, with two or three branches; when it is done, so to say, suddenly.—2. By putting in the urethra a tent of sponge, or a bit of dried gentian root, a rather milder proceeding. This last is undoubtedly the best method; and the urethra may be so enlarged, that we may introduce a whole finger into it; but beyond this degree there is danger of consecutive incontinence of urine, and incision is to be preferred. We should be aware also that the dilatability of the urethra is greater in young than in old subjects.

SECTION II.—OPERATIONS PERFORMED ON THE VULVA, VAGINA, AND UTERUS.

We shall not specially treat of removal of the clitoris or nymphæa in a state of chronic induration, or of cancer; the rules are the same as those for extirpation of tumours generally.

We may also apply, to foreign bodies in the vagina, the means of extraction recommended for those of the rectum; but I must mention that, in order to withdraw a metallic pessary, Dupuytren was obliged to divide it by means of a small saw introduced in the vagina; and that, in a case of very large pessary, Lisfranc commenced by incising the front of the perineum to make a more open way for it.

(1.) *Imperforation of the Vagina.*

There are two degrees of imperforation of the vagina. Either the hymen only is obliterated, and it suffices to divide it crucially and ex-

* The following is a case of lithotomy in the female, without dividing the meatus and anterior portion of the urethra, by Dr. Baker, of the State of New York:—"The patient, aged forty-nine, was placed on the table, and secured in the usual way. A straight grooved staff was introduced through the urethra, and the stone felt with the beak of the instrument. The incision was now commenced by dividing the urethra half an inch posterior to the meatus urinarius, with a sharp pointed bistoury guided by the groove of the staff. The beak or probe-point of the lithotomy knife was introduced through the opening thus made in the urethra into the groove of the staff, and pushed forwards along the groove, in a direction obliquely outward and downward until it penetrated the bladder, and the incision continued until of a sufficient size to admit the forceps. The knife was now withdrawn, and the forceps introduced. A stone, about the size of a nutmeg, was grasped and withdrawn. The search was resumed, and another stone secured and removed; and so on to the number of ten, varying very little in size. No more stones being found, the bladder was carefully washed out with warm milk and water, and the patient put to bed."—Phil. Med. Examiner, July, 1845.

cise the four flaps; or there is a greater thickness of parts between the exterior and bottom of the vagina; and in this case, until lately, they waited until the tumour formed by the accumulation of the menses, which could at all events be felt by the rectum, served as a guide for the bistoury; but the consecutive inflammation, and the decomposition of the blood retained in the interior, produced accidents almost inevitably mortal; so that Boyer regarded this anomaly as beyond the resources of surgery, or at all events refused to operate for fear of compromising the art. M. Amussat has opened to surgeons an entirely new way, which promises the happiest results.

Method of M. Amussat.—The vagina of a girl, fifteen and a half years of age, was obliterated in at least two-thirds of its extent: the accumulated menstrual discharge formed a fluctuating tumour. The patient having been prepared by a bath, a lavement and a poultice on the vulva, the surgeon, taking a large straight bougie, applied its extremity below the urethra, where the orifice of the vagina should have been, and pressed in the direction of the vagina, so as to push back the mucous membrane, and produce a slight dimpling. He repeated this manœuvre with the little finger, after having first put another finger in the rectum to serve as a guide; the pressure was painful, but already efficacious, and the impression of the little finger remained.

The better to attain his end, he then drew backwards the perineum, by grasping it with a finger in the anus, and the thumb in the vulva; while on the other hand he endeavoured to draw up the urethra, to separate it from the rectum, and leave more space between them. There remained a hole without any rent or effusion of blood. To preserve the dilatation, he placed in this little indentation, like the finger of a glove, a prepared sponge. Three days afterwards he repeated the introduction of, and pressure with, the finger; and passed in two fingers to effect a greater distension; there was, in fact, a complete rent in the mucous membrane, with effusion of blood. He replaced the prepared sponge. After five other trials made in this manner, at intervals of a day or two, he had created an artificial passage nearly two inches long; then to the bottom of this canal he directed, on the index-finger, a trocar, which he plunged into the tumour; then replacing the trocar by a bistoury guarded with lint for five-sixths of its blade, he had no more than a thickness of half an inch to traverse. From fourteen to sixteen ounces of black and viscid blood followed. He introduced into this new vagina a large gum-elastic catheter; and after several accidents the cure was accomplished, and has remained so now for many years.

(2.) *Proceedings of Exploration.*

The application of the stethoscope on the abdomen, to distinguish pregnancy from some diseases of the uterus, has been tried with more or less success. M. Nauche has proposed a stethoscope, which is applied on the vaginal orifice of the uterus, and which he has named the metroscope. The hand applied on the hypogastrium, with careful manipulation, furnishes some help to the diagnosis; lastly, we can ex-

plore the wound by the rectum. But the two principal and essential methods are, the "toucher" and the application of the speculum.

I. OF THE "TOUCHER." *First Proceeding.*—The woman stands, resting against a fixed point, a wall or the edge of a bed, the thighs separated; the surgeon places himself before her, sitting, or better still, the left knee on the ground, the other raised to support the elbow, if necessary; he passes the right hand under the clothes, the index-finger having been previously anointed with oil or mucilage, the thumb abducted, the other fingers doubled into the palm of the hand: the radial border of this finger is passed horizontally, and from before backwards, under the perineum; the labia majora are easily separated, and, on bringing back its extremity from the coccyx to the pubis, it penetrates surely, without violence, into the vaginal orifice. He then pushes it into the canal, following its known direction; passing it lightly over the parietes, to assure himself that there exists nothing abnormal. Arrived at the neck of the uterus, the finger glides under it, and behind it; gently, and without effort, explores with the point its whole surface; recognizes its orifice, presses with circumspection on its different points to appreciate its sensibility and temperature; raises the womb completely, to take cognizance of its height, its mobility; fixes it, and measures it approximately, conjointly with the other hand applied upon the hypogastrium, and pushing deeply into the groove which surrounds the os tinæ.

Before withdrawing the finger, he should note in his memory every discovery he has made, and verify it afresh.

Finally, the operation terminated, he examines that which is brought away on the finger; and the better to appreciate its colour, he wipes his finger on a white towel before washing his hands.

Second Proceeding.—The woman is laid on her back, or, at all events, inclined on her side, the head supported, the shoulders a little raised, the thighs semi-flexed, and sufficiently apart; and, lastly, the pelvis more or less raised, to render the introduction of the finger more easy and the uterus more accessible. The surgeon places himself on the right side of the bed, if possible, in order to be able to use the right hand, slips his hand under the clothes, and makes use of it as in the first proceeding.

When the uterus is situated very high, instead of closing the three last fingers, we straighten them; so that the radial aspect of the middle one shall apply itself against the perineum, and support it, while the thumb, stretched forward, supports, in like manner, the anterior part of the vulva.

If this is not sufficient, we introduce the middle with the index-finger; we may thus reach about half an inch higher. Under some circumstances even, we introduce the whole hand; but this is rare, except during labour.

In general, the rectum should be previously emptied; for, if it is not, it compresses the vagina, pushing forward its posterior walls, and rendering the body of the uterus more difficult of access.

The "toucher" in a standing position is more suitable for appreciating the weight, elevation, and direction of the womb, and to obtain

the "ballottement" of the foetus; but, if we wish to explore the vagina, the neck of the uterus, or even many affections of the body of the uterus, the second proceeding is much preferable, as it permits more easily to combine with it, palpation of the hypogastrium.

II. APPLICATION OF THE SPECULUM.—The external orifice of the vagina is not placed, at least in those women who have not had children, in the direction of the vagina itself. In fact, the posterior half of this opening, formed by a transverse fold, flattened from above downwards, which is called the "*fourchette*," leaves, above and a little behind it, a small cul-de-sac, formed by the inferior posterior part of the vagina; hence it follows that, if the speculum is presented at once in the direction of the vagina, it tends to push in this fold, which forms an obstacle; it causes acute pain; and, lastly, it is not successful. We must then commence by directing the instrument from before backwards, and very slightly from below upwards.

The dimensions of the vaginal orifice are very variable. In virgins it is partly closed by the hymen, which must not be injured unless positively necessary. Moreover, it is important to know, that in young women it is exceedingly dilatable; it is less yielding in adults; and after the cessation of the menses its rigidity goes on increasing, so that at a very advanced age, instead of feeling at this orifice a supple ring, yielding under the fingers, we find it hard and splitting at the slightest effort made to overcome its resistance; it then sometimes scarcely admits the little finger; and the vagina itself, instead of offering its usual rugæ, presents polished walls, and a very constricted capacity. The result is, that in young women, however narrow the orifice may appear, we may confidently rely on its dilatability: that in adults we must not place so much reliance on it, and must use a speculum not much larger than the apparent capacity of the orifice; and, lastly, that at a later period we should be more reserved in employing the speculum at all; proceed with gentleness, and caution, in order to avoid lacerations, which cicatrize with difficulty; and use only a very small speculum. Lisfranc has found it necessary to prepare the parts, during eight or ten days, by dilating them with prepared sponge.

The labia majora, especially, by their obliteration contribute to the enlargement of this orifice, and even of the vagina itself, as we see in labour, when the head of the foetus is passing out of the vulva. They should also yield as much when a large body is passed into the vagina, instead of out of it. On which account the assistant, whose duty it is to put aside the labia majora, when the speculum is presented to the vagina, should let them go as soon as the introduction is commenced; unless this is done, the parts will be strained, and the vagina, deprived of this assistance to its dilatation, will offer a less free passage to the instrument.

Operation. (*Lisfranc.*)—The instrument preferred by M. Lisfranc is the slightly conical pewter tube of M. Récamier, furnished with the round-headed mandrel of Galenzowski, copied by Méliér; but as the ordinary length of five to five inches and three-quarters is not sufficient for all women, he has prolonged it to seven inches; and he rejects the

cleft or solid handles four inches long, the use of which remains to be demonstrated. A handle, an inch or one and a half long, suffices for the application of the instrument, and renders it much more easy to carry. Moreover, there are speculums of several diameters, marked by the numbers one, two, and three.

The woman should be laid across the bed, the sciatic tuberosities on a level with its edge, her feet placed on two chairs, her thighs sufficiently apart, her head supported by a pillow, and another pillow under the pelvis to prevent it from pressing down the edge of the bed, and to assure a horizontal position to the whole trunk. The instrument should be oiled, and properly warmed. If daylight is used, the patient should be placed opposite the light; if not, an assistant, placed on the left side, holds and directs a candle to the taste of the operator.

The surgeon, standing between the patient's thighs, commences by performing the "toucher," to assure himself of the position of the neck of the uterus, so that he may explore it in a more certain manner; with the left hand he puts aside the hair and labia minora: with the right he grasps the speculum, the index and middle fingers holding the handle, the thumb inside the instrument where the handle joins it; presents it to the vulva, the handle turned towards the mons veneris, and gently introduces it. If the fourchette is of considerable extent from before backwards, care must be taken not to drag the perineum transversely, which would stretch it still more; but on the contrary the perineum should be drawn backwards. The instrument, corresponding well to the centre of the vagina, should be first directed in a line, passing from the centre of the vaginal orifice to the inferior part of the coccyx; and, when it has entered to the depth of one inch, it should be brought into the direction of the sacro-vertebral angle.

As the speculum advances, the woman makes involuntary efforts, the vagina resists as it were, presses on the speculum, and presents, at the extremity of the instrument, a collar, with an opening in its centre, which is formed by the contracted walls of the vagina. In this manner, the entire surface of these walls is gradually exposed, perpendicularly, before the operator, as the speculum unfolds it in entering. The orifice of this collar is directly in the centre, when the neck of the womb itself occupies the centre of the vagina; but, if it inclines to one side or the other, the orifice generally follows the same direction, and is approximated to the side of the collar; so that the most extensive segment of the vagina is almost always diametrically opposite to the side to which the neck inclines. This particularity may, to a certain extent, indicate the direction of the neck of the uterus, when farther exploration is wanting.

This collar, having some resemblance to the neck of the uterus, might mislead; but the neck has no rugæ like the vagina, and its colour is not the same. When inflamed, the neck is browner than the vagina; in a healthy condition, on the contrary, the mucous membrane of the vagina is pale, that of the neck is paler still. To remove all doubt, the presenting part need only be gently pushed with a female sound: if it is the vagina, it may be pushed back with the slightest

effort. When the neck of the uterus is perceived, it should be inclosed in the end of the speculum.

Sometimes the neck is so inclined backwards, that it cannot be seen. In this case the speculum must be drawn back about one inch, and its handle being raised and brought forwards, its extremity should be directed between the posterior wall of the vagina, and the neck, so as to raise the latter forwards, and expose its posterior surface at the end of the speculum. In this manner, when the neck is too large to be seen entirely at one glance, its extremity may be moved from side to side, so as to lay bare successively all its surfaces; and it is only necessary to incline the instrument in different directions to explore its entire extent. But these manœuvres require complete insensibility of the neck, otherwise they would not be without danger.

When the speculum is conveniently placed, it may be secured by gentle pressure; a little dossil is then passed up it to clean the parts exposed, which should now be examined. The inferior lip of the neck may even be raised with a probe or female catheter, when ulcerations in its interior are suspected.

Speculums with two or many branches are also used; the latter should have a rather long handle, to assist in the separation of its branches. The introduction is easy, but the separation of the branches taking place in the interior dilates the vagina, whilst the labia majora cannot assist in its enlargement, and there are, consequently, sometimes painful strainings. This separation also leaves between the branches a larger or smaller interval, in which the parietes of the vagina protrude, and mask the view, unless the dilatation is carried to an excessive extent. Lastly, notwithstanding every precaution, it often happens that the branches, in shutting, pinch the mucous membrane of the vagina. An inconvenience that might be avoided by withdrawing the instrument open; but this manœuvre is not easy.

In fine, these speculums should only be used when great dilatation of the upper part of the vagina is required; for example, when it is desired to seize the neck of the uterus to amputate it (Lisfranc).

(3.) *Laceration of the Perineum.*

When only the anterior part of the perineum is lacerated, we do not attempt to remedy it; when its central part, nature herself will close the opening; but when the laceration is complete, and the vulva and anus are united into one common cloaca, it must be cured by suture, either interrupted or twisted. Dupuytren preferred the latter, though he succeeded with the other also. The important point is to leave the threads in until union is complete and solid; which takes place by second intention only, and often requires a month or more for its completion.

In a case of laceration of long standing, where partial cicatrization gave reason to fear lest retraction of the edges of the division would tear out the stitches, M. Dieffenbach had recourse to lateral incisions, after the method of Celsus, so as to prevent any strain of the integuments.

Proceeding of Dieffenbach.—The patient was placed as for the ope-

ration of lithotomy; and, the parts having been previously well shaved, he refreshed the edges of the laceration with a bistoury and scissors. Then he proceeded to bring them together; first, by a point of interrupted suture, placed in the centre of the laceration, and which comprised a portion of integument, four lines in width, on each side: two points of twisted suture were then made in front of this point and two others behind it, as far as the anal orifice; and, lastly, a slight laceration, which extended into the rectum, was united by two threads, applied by means of a very fine sewing needle.

When the edges were brought together, the operator made on the left side a first incision, which, commencing half an inch outside the posterior edge of the left labium, was brought from above downwards, in the shape of a bow, first outwards, then inwards, and finished on the side of the anus, about one-third of an inch in front of it. A similar semi-circular incision, with its convexity also outwards, was made on the right side of the suture; the portion of skin comprised between the laceration, and each incision, was about two-thirds of an inch wide, at the point corresponding to the greatest convexity of the incisions.

These incisions were scarcely finished before their edges separated considerably, and so caused all strain of the suture to cease; and in addition, all the middle portion circumscribed between the two semi-lunar incisions, sunk half an inch below the level of the surrounding skin, so that the patient was able to turn in her bed without disturbing this portion in her movements. From the fourth to the seventh day, the points of suture were successively removed; care was taken to soften the excrements by lavements; but the first stool, on the eighth day, caused a fissure, near the rectum, which fortunately healed in a short time.

This observation seems, then, to demonstrate afresh the necessity of leaving the points of suture longer *in situ*, until the cicatrix is solid, and out of danger of laceration.

Proceeding of Roux.—It consists simply in the employment of the quilled suture, after the edges of the wound have been carefully refreshed.

A great number of successes have already followed this proceeding, which seems to merit preference as the general method.

(4.) *Laceration of the Recto-vaginal Septum.*

We may apply to this laceration the same proceedings as to simple laceration of the perineum. Noël, in a case of this kind, refreshed the edges with a scissors, and united by the twisted suture. It succeeded completely; but the failures are much more numerous, and should induce us to prefer the proceedings adopted for simple laceration of the perineum.

(5.) *Entero-vaginal Fistula.*

This name is given to a lesion, in which some portion of the intestinal tube above the rectum opens into the vagina, and empties the fecal matter into it by a real abnormal anus.

Proceeding of Roux.—In a case where the ilium terminated in the vagina, he opened the abnormal parietes, separated from the vagina

the portion of intestine that terminated in it, and tried to invaginate it into the inferior end by means of suture. The patient died, and the autopsy demonstrated a mistake, which it is not easy to avoid; viz. that instead of invaginating the portion of the ilium in the inferior end of the large intestine, it had been united to its superior end.

Proceeding of M. Casamayor.—This is a very ingenious application of the proceeding of Dupuytren, for the cure of abnormal anus. The instrument of M. Casamayor is an enterotome, each branch of which ends in an oval plate, three-quarters of an inch wide, indented on the corresponding surfaces. One of these branches is introduced through the vagina and fistula, into the superior end of the intestine, the other through the rectum, to a level with the first. These plates are intended to approximate the corresponding walls of these two portions of intestine, and to produce, by their constriction, a loss of substance which allows the fæcal matter to pass from one into the other.

This proceeding, performed once, seemed to have succeeded, when the woman died in consequence of some imprudences. Whatever objections may be made to it, it is evidently much less dangerous than that of M. Roux, to which it should always be preferred.

(6.) *Recto-Vaginal Fistula.*

This term is applied to laceration of the septum not implicating the perineum, and we may employ all the means used for curing vesico-vaginal fistula. But the successful cases have been rare; and the following proceeding, which was successful in the hands of Saucerotte, points out at the same time the cause of the failures and the remedy.

Proceeding of Saucerotte.—He dilated the vagina with a speculum with two branches, and passed a wooden gorget into the rectum through the anus, with its convexity under the fistula to serve as a support for the other instruments. The opening being thus visible, he pared off its edges, half with a bistoury guarded with linen to within a few lines of its point, half with a kind of cutting rasp; then he united by the glovers' suture, applied by means of two curved needles, a short one to begin with and a longer one to finish with. He passed the first needle, armed with a double thread and mounted in a *porte-aiguille*, to a level with the superior angle of the fistula, where he fastened the ligature by means of a bit of diachylum, so as not to be obliged to make a knot; then with the second needle he made six points of suture, whipping or overcasting (*en surjet*), proceeding from behind forwards; and lastly knotted the ends of his thread over a foreign body so as to fasten it. For some days he expected a cure; but at the first stool the suture was torn. The surgeon repeated the operation; but this time he took the precaution to completely divide the anus, so as to transform the fistula into a laceration of the perineum and recto-vaginal septum. The success was complete.

(7.) *Vesico-Vaginal Fistula.*

There are six methods for curing these fistulæ, viz. *simple approximation of their edges—cauterization—suture—uniting apparatus—elytrophlasty—and obliteration of the vagina.*

I. APPROXIMATION OF THE EDGES OF FISTULA. *Proceeding of Dessault.*—He placed a permanent catheter in the bladder, to carry off the urine as soon as it should reach this reservoir; and by means of a large cylindrical plug, which he passed from before backwards into the vagina, he pushed back the anterior lip of the fistula towards the posterior, so as to keep them in contact and reduce the fistula to the condition of a transverse cleft. The sound was retained in place by means of a curved metallic support, attached to a truss; and the end of this support, pressed on the vulva, received the handle of the catheter in a hole made on purpose.

M. Chailly attempted to place the woman on her belly, to favour the flow of the urine through the urethra; but the patient could not retain this position.

II. CAUTERIZATION.—It may be applied by means of the actual cautery,* or caustic substances. Nitrate of silver is generally preferred. The vagina is dilated by means of a double-bladed speculum; and a bit of nitrate of silver, fixed at right angles on the end of an ordinary forceps, is passed in such a way as to cauterize, not only the vaginal surface of the opening, but also the free border of its two lips. This may very well be substituted for the special instruments. Perhaps even, if the fistulous orifice showed itself in the fold of the vagina which we have spoken of, when the ordinary speculum is used, it would suffice to pass the nitrate of silver at the end of a simple portecrayon.

III. SUTURE.—This method is performed in two stages, the proceedings for which have varied, viz. the paring of the edges of the fistula, and the application of the sutures. We must premise that in all cases the patient should be placed as for perineal lithotomy.

1. *Paring the Edges.*—M. Malagodi, having a case in which the longitudinal fissure was large enough to admit a finger, passed the extremity of the index-finger, covered with a glove, into the bladder through the fistula, and used it as a crochet to bring successively the two lips of the wound into the vulva, and was thus enabled to easily remove their callous edge with a straight bistoury.

M. Roux in an analogous case had two forceps made, one for the right, the other for the left side, the ends of which were of unequal breadth, but of equal length; so that the inferior end, being double the width of the superior, presented a solid support to the bistoury as it divided the parts which were held by the forceps, and which passed beyond the edge of the upper end. The surgeon began by slightly

* If the loss of substance be slight, and the wound small, there is no doubt that a cure may be obtained by this means. Dupuytren, who first proposed it, cured several; Dr. M^r Dowell one; Dr. Kennedy two; Mr. Liston four or five; and others have been equally successful. The woman may be placed upon her back as for lithotomy, or better upon her hands and knees—a double-branched speculum, or three brazen spatulæ, or a metal cylinder, closed at its extremity, but with an opening in its side corresponding to the fistula, may be used. The canterizing iron should be *lightly* applied around the edges of the wound. The operation should not produce a slough, or the patient will not be benefited, but merely a corrugation or shrivelling of the edges; but it must in candour be confessed, that, whilst it is not difficult or uncommon to benefit the patient to a great extent, a complete closure of the fistula is very rare.—*Vide* Dr. Churchill's Midwifery, p. 419.

enlarging the fistula before and behind, then he tried to seize the right lip, which was only accomplished with difficulty. This lip was refreshed with the bistoury and scissors; then he passed to the lower lip, which was more easily operated on. We should remark that M. Roux had first tried to use a speculum; but, being more inconvenient than useful, it was found necessary to withdraw it. M. Nægelé invented a kind of bistoury enclosed in a sheath, which he passed to the edges of the fistula; but he has forgotten to mention the support against which the bistoury should cut.

It will be seen that this point of surgery requires fresh researches. In fact, with the exception of the proceeding of M. Malagodi, which cannot always be imitated, the others, even with special instruments, are not sure nor easy. The scissors, twice curved at a right angle, with short blades and blunt points, seem to us much preferable, the more so as they serve for both sides. But this again is only serviceable for longitudinal fissures; and, to refresh the edges of transverse fistulæ, we have only caustics, particularly nitrate of silver, which is proposed by M. Lallemand as the general application.

2. *Application of the Sutures.*—M. Malagodi, in the above-mentioned case, brought one of the edges of the fistula into the vulva, as he had done in paring the edges, and passed in a small curved needle, about two lines outside its posterior extremity. He brought the needle, by a circular movement, from the bladder into the vagina, through the vesico-vaginal septum, and immediately disengaged it. He then passed a second needle, threaded on the other end of the same ligature, in a similar manner, through the opposite lip of the wound. Two other ligatures were placed in a similar manner, then tied separately and cut off near the knot. Perfect re-union took place at the two posterior points of suture; the anterior tore the tissues, but cauterization with nitrate of silver completed the cure. M. Roux employed the twisted suture. He passed a curved needle, armed with an ordinary thread, bearing a small metal bar at its extremity, by means of a common porte-aiguille; first, from the vagina into the bladder through the left lip of the wound; then from the bladder into the vagina through the opposite lip. Three metallic bars were thus put in; then a loop of thread was passed over the first, and crossed over the others, as in the ordinary twisted suture. The operation—paring the edges included—took up two hours; the patient died on the second day.

M. Lewzinsky, in a case of transverse fistula, conceived a plan of passing the needle from the bladder itself. A silver canula, slightly bent at its extremity, was to be introduced through the urethra; in its curve was to be placed a common curved needle armed with a thread, which needle was to have been pushed forwards by a watch spring placed in the canula; the beak of the canula being placed on one of the lips of the wound, the operator would pass his left hand into the vagina, to extend alternately the anterior and posterior lip of the wound; then he would push the needle through them, withdraw it through the vagina, and re-introduce it afresh from the bladder, by means of the canula.

M. Deyber has improved this instrument. Instead of a spring and separate needle, a needle-shaped stylet passes through the canula. The eye is situated near its point, so that, when the latter has penetrated into the vagina, one of the ends of the thread it carries is retained; the stylet is withdrawn into the canula, and pushed through the other lip, when the other end of the thread is disengaged.

But you are still obliged to withdraw, and re-introduce the canula for each point of suture. It would be more expeditious, in our opinion, to thread the stylet with a ligature long enough to suffice for all, which, moreover, would pass in the canula. When the stylet has traversed the vagino-vesical septum, only a portion of the thread it bears should be withdrawn; in this manner, three or more ligatures might be placed without any necessity for withdrawing the canula from the bladder.

M. Nægélé recommends a needle analogous to that of Deschamps, but with which it is necessary to puncture the lips of the wound from the vagina to the bladder, which exposes the latter to the danger of being pricked. We shall not then describe it; only we must mention that, instead of tying the threads, he collects them into a bundle, which he twists on itself until the patient feels a slight constriction of the lips of the wound; this bundle he then fixes on the mons veneris with sticking plaster. It is a loop suture, according to the proceeding of Ledran.*

M. Nægélé traverses the two edges of the wound with curved needles, by means of a forceps, which acts the part of a *porte-aiguille*; round these needles, which are left *in situ*, he twists the threads as in the ordinary proceeding.

IV. UNITING APPARATUS.—It has been attempted to bring together the lips of the opening by means of plates, hooked forceps, and hooks of various shapes; and the names of Nægélé, Dupuytren, Laugier, and Lallemand, are appended to four instruments of this kind; none of them offer sufficient security and facility to counterbalance the inconvenience of new and complicated instruments, on which account we shall confine ourselves to the mere mention of them.

V. ELYTROPLASTY.—This method, invented, and already several times successfully applied, by M. Jobert, consists in placing between the edges of the fistula, previously refreshed, a portion of the soft parts borrowed from the labia majora, or from the nates, or from both at once, and maintaining it *in situ* until complete adhesion has taken place. The edges are refreshed with a cutting instrument, as for the suture. The hair having been previously shaved off, the surgeon causes the labium to be twisted, or twists it himself, with one hand, in order to put the integuments on the stretch; he then places his bistoury on the external side of the labium, carries it along, depressing

* Mr. Beaumont has described an ingenious instrument for passing the sutures. "The instrument is in the form of a forceps, one blade of which is a needle, curved towards its point, close to which is its eye. The other blade is broader on its opposing surface, less curved, and at its extremity has a hole through which the needle-point and just the loop of the ligature are carried when the blades are closed. On the back of the broad blade is a spring which, when pushed forwards, the blades being previously closed, catches the ligature on its point and holds it."

his wrist; and, as the instrument approaches the hand that extends the integuments, carrying the latter slowly backwards, still keeping up its traction on the skin, whilst he continues the incision; reaches the internal side of the labium, the wrist being made to describe a semi-circle; and, lastly, finishes the incision on a level with the point at which he commenced; there results a large flap, with a rounded apex, which is suited for large fistulæ. For narrow openings you may cut your flap by means of two incisions, which commence one outside, the other inside the labium, and reunite below at an acute angle; the skin is then dissected off from without inwards, and from the summit of the flap towards its pedicle, comprising with it several layers of soft parts, in order that it may retain more vitality.

This flap should be proportioned to the extent of the fistula, allowing for its retraction during suppuration. It is for this reason that M. Jobert advises prolonging the incisions as far as the nates; but, in very fat women, it is better to cut the flap from the length of the labium; for, if cut from the nates, it would be too thick, and not easily introducible, or if too much deprived of adipose tissue, it would become gangrenous. The pedicle should be as large as the flap itself, and should be attached to the part next the vagina; it should also be made rather too long than too short, in order to avoid dragging and gangrene.

When the flap is cut proceed to its introduction into the fistula. First bend it double, or roll it on itself, and traverse it at its summit with a waxed thread of moderate size; then introduce, through the urethra into the bladder, a sound, which should pass through the fistula, and project into the vagina: pass the two threads into the eyes of the sound, and in withdrawing it, you bring through the urethra the threads, which disengage from the instrument: then, whilst you draw the threads gently with one hand, push the flap with the other, and so put it in place. It only remains to fix it by suture.

To effect this, introduce your left index-finger along the flap to one of the angles of the fistula; on this finger pass a curved needle mounted in a "porte-aiguille," or directed with the hand only, and push its point at once through the flap and lip of the fistula; then seize the needle with dressing forceps, and bring it outside with its thread. Make a second point of suture at the opposite angle of the wound. It is of the greatest importance that each of the angles of the fistula be comprised with the flap in a loop of thread; the omission of this precaution once caused the operation to fail.

The threads, being once passed, should be tied in a double knot, and then be left to hang outside, after having been enveloped in such a manner that you can recognize them; or, they may be tightened in a *serre-nœud* left in. A permanent sound is placed in the bladder, care being taken that the flap is not pushed; and it should be prolonged by the addition of another, to guide the urine to a distance from the parts. This sound should be continually open, and supported by threads tied to the body bandage. The patient should maintain the horizontal position, and perfect repose. The threads come off, on from the tenth to the fourteenth day; but, to avoid all danger, M.

Jobert does not cut the pedicle until from the thirtieth to the fortieth day.*

VI. OBLITERATION OF THE VAGINA.—Proposed by M. Vidal de Cassis. It cannot be attempted but on women who have passed the critical age; but even then there is a great difficulty, which experience has revealed to M. Vidal himself. It is that the urine, which accumulates in the vagina, opposes the success of the suture, by means of which the passage is to be obliterated.

Appreciation.—The proceeding of Desault is evidently insufficient. Cauterization, though very useful for small fistulæ, by favouring the formation and contraction of inodular tissue, is not suitable for those of larger size. There remains paring of the edges with their re-union, by suture, or by means of the elytoplastic flap. This latter proceeding is, up to the present time, that which has procured the most numerous and lasting successes. I have been able to assure myself of two, in the wards of M. Jobert, at the hospital of St. Louis.

Moreover, here, as in urinary fistula in the male, the contact of the urine forms the essential obstacle to re-union. I imagined that this might be remedied by the continual irrigation of the bladder with tepid water: but this idea has not yet been put in execution.

(8.) *Inversion of the Vagina and Uterus.*

Under this name are confounded affections very different, and but little known. From special researches, made at the "*bureau central*," during five years, I have come to the conclusion that prolapsus uteri

* M. Jobert has lately performed a new operation, called by him *autoplastic union by sliding or transposition*. The following case contains the details of the operation:—"A woman was received at St. Louis with a vesico-vaginal fistula, caused by parturition: the urethra was completely destroyed, and the loss of substance, which was seated in the septum vesico-vaginalis, extended inwards, on the mesial line, to about half an inch from the cervix uteri; there existed, consequently, a large cloaca, into which the urine fell ere it escaped from the vulva. Several modes of treatment were employed; among others, the auto-plastic method (elytoplasty), but without success; and the patient left the hospital very little better than when she entered. A year afterwards she came back, and, on the 9th of June, 1845, the following operation was performed (which the author denominates *re-union autoplastic par glissement*):—a transversal, semi-circular incision was made on the anterior portion of the neck of the uterus, where it joins the vagina; the flap thus obtained was dissected from below upwards, the edge of the bistoury being constantly directed towards the uterus, to avoid wounding the bladder; immediately after this incision and dissection, by which the fundus of the bladder was isolated, the anterior portion of the vagina was drawn inwards, and a change of position of the posterior region of the bladder, by which the edges of the part could be placed in contact and kept united, and the loss of substance repaired with great facility, even when considerable, as in the present instance, thus effected. The patient, whose case has been just related, is at present in the following condition:—1. There is, at the upper extremity of the vagina, a thick and solid cicatrix, which supports the bladder. 2. In front of the cervix uteri there is a swelling caused by the bladder and the upper part of the vagina, which are detached from the cervix. 3. There is a furrow directed from before backwards, indicating the spot in which the two edges of the fistula were united. 4. Before this furrow, and at the spot corresponding to the neck of the bladder in the normal state, there is a small opening into which a catheter can be passed. 5. The urethra no longer exists, but the newly-formed vesical orifice "seems to perform its functions perfectly. 6. The urine can be retained several hours; the patient feels the desire of evacuating it, and effects this at will. 7. When the patient moves about, the urine is not so easily or perfectly retained."—*Med. Times*, Aug. 2, 1845. See also Ranking's Abstract, vol. ii. p. 115.

is not so frequent as is commonly supposed; but is, nevertheless, much more common than simple prolapsus of the vagina, of which I have as yet found but three cases: that vaginal cystocèle, which is believed to be of rare occurrence, is the most frequent of all these prolapses; and, finally, I recognized the rather frequent existence of a prolapsus, unknown to any French authors, and which I have named *vaginal rectocèle*. All these lesions may be combated with pessaries; we shall return to them in another article. Lately, a great number of operative proceedings have been proposed for the radical cure.

1. *Excision of some Folds of the External Orifice of the Vagina*—performed by M. Dieffenbach.

2. *Excision of a large longitudinal flap of the vaginal mucous membrane, either elliptical (Marshall), or quadrilateral (Ireland), and immediate reunion of the wound by the suture.*

3. *Cauterization of this mucous membrane, in order to obtain by suppuration an inodular tissue, sufficient to retain the vagina fixed to the neighbouring organs (Laugier).*

4. *Excision of the semi-circumference of the vaginal orifice, and its immediate reunion by suture; operating either on its anterior or posterior semi-circumference.* I thought that this method offered more advantages than the others, and tried it on one occasion in the *Hôpital Saint Louis*; but an abundant white discharge, which came on, destroyed all the effect of the sutures, which had been applied on the posterior semi-circumference of the vaginal orifice.

5. *Episioraphy*, by M. Fricke, of Hamburg, which consists in making raw the internal surface of the labia majora, and then uniting them by suture.

6. *Obliteration of the Vagina*, proposed by M. Romain, of Gerardin.—It consists in depriving the vagina of its mucous membrane, by the bistoury, in its entire circumference, and in the extent of one inch and one-third; then reuniting by position and compression. Of course this operation is not applicable until after the critical age is passed; it has not yet been attempted.*

Appreciation.—From experience, and from the very nature of most of these proceedings, it seems that not one of them can produce radical cure. Most of them merely push back the womb into the vagina, and change the extra-vulvar into an intra-vaginal prolapsus. Moreover, they all have to surmount the obstacle presented by the vaginal discharge, which almost necessarily follows the operation, and hinders the adhesion from taking place. Perhaps the proceeding I have pointed

* Professor Chaumet recommends the following operation:—1. Remove a portion of one side of the walls of the vagina, as advised by Marshall Hall and performed by Drs. Gerardin and Laugier, Professors Velpeau and Berard. 2. Amputate the whole or part of the cervix uteri. The advantages to be derived from this modification are: (a) a modification in the size and weight of the uterus; (b) a decrease of the hypertrophy, first by the loss of blood which will necessarily follow the operation, and next by the suppuration which inevitably takes place; (c) the contraction of the cicatrix of the remaining portion of the cervix, and its union with that of the vagina. In a case operated on by Professor Chaumet, the result was in every respect satisfactory, and although eight months had elapsed, and the woman had been occupied in the most laborious duties, she continues cured.

out, which consists in uniting the anterior semi-circumference of the orifice of the vagina by suture, would obviate this obstacle.

Reduced to simple palliatives for prolapsus of the uterus, will these proceedings be more efficacious for prolapses of the bladder, vaginal rectoceles, and the so rare prolapses of the vagina itself? I know of but one case in which Marshall's proceeding was applied; it seemed to have succeeded, but the patient was not examined again a sufficiently long time after the operation to allow the cure to be looked on as complete.

M. A. Bérard presented to the Academy of Medicine a woman who, during three months, seemed to have been cured of a prolapsus uteri; but two months afterwards the prolapsus returned.

(9.) *Retroversion of the Uterus.*

Reduction, support by means of pessaries, and, lastly, puncture, when conception has taken place in a womb thus displaced, have all been applied. Puncture and the application of pessaries will be treated of separately.

Proceedings of Reduction.—Most authors recommend to place the woman on her elbows and knees. M. Moreau has several times tried this practice, and has always been obliged to give it up. The woman cannot retain this position long. In the first attempts at reduction the compression of the uterus causes a peculiar enervating pain, similar to that caused in man by pressure of the testicle, and which subdues their strength, and causes them to fall flat on their bellies. M. Moreau prefers placing them as for the reduction of a hernia, with the legs flexed on the thighs, the thighs on the abdomen, and the head bent on the breast. The index and middle fingers are introduced into the vagina, the body of the uterus is pushed upwards, and its neck is hooked up with the index-finger to bring it downwards. This method succeeds ordinarily in the simplest cases.

If it does not suffice, we are advised to pass two fingers into the rectum, to push back the uterus upwards, and two other fingers into the vagina to seize the neck and bring it down. M. Moreau never succeeded by this manœuvre; and he thinks that the simultaneous introduction of two fingers into the vagina and rectum is impossible in most well made women; and again, even when effected, either the fingers are too short, or there is not room enough to move them properly, and accomplish the necessary replacement of the organ.

For these cases several resources have been proposed; for instance, to hook up the neck by means of a curved sound, introduced into the bladder with its concavity turned backwards (Bellanger), and to introduce the entire hand into the rectum in imitation of Dusaussais.

The proceeding of Evrat is more simple and safe, and is the one with which Moreau has had most success. The woman should lie on one side; a rod eight or nine inches long, furnished with a pledget of lint smeared with grease at its extremity, is introduced into the rectum to push the fundus of the uterus from below upwards, whilst its neck is caught by two fingers passed into the vagina to pull it downwards and backwards. M. Moreau had made for this purpose a rod, termi-

nated by a little sphere, which is enveloped in a pad of carded cotton, covered by a bit of glove.

To disengage the uterus more easily, M. Capuron recommends causing it to execute a semi-rotation, by pushing its fundus from the right side, to cause it to pass in front of the sacro-iliac symphysis. In all cases of displacement Désormeaux laid it down as a rule, that the uterus should be replaced without regard to the swelling that may have come on. M. Hervez de Chégoin very properly excepts cases in which the swelling would render the reduction too difficult; in which case it should be first overcome.

(10.) *Application of Pessaries.*

Pessaries are distinguished according to their shape, and especially according to their object; some, intended to prevent prolapsus of the vagina, or to support vaginal hernia, are called *vaginal pessaries*; the others, called *uterine pessaries*, are for the purpose of remedying procidentia,* or displacement of the uterus, whether backwards or forwards.

I. VAGINAL PESSARIES.—Some, called "*pessaries en bondon*," represent a hollow cylinder, of large enough diameter to fill up the vagina, and three or three and a half inches long. M. J. Cloquet has substituted for these the *pessaries elytrôïdes*, which are slightly flattened, concave in front, and a little expanded at their extremity; and which offer but a very small canal in the centre. M. Amussat uses small cylinders of ivory; others use uterine pessaries indifferently. Those, which seem to me the most convenient, are made of gum-elastic, presenting a funnel of more or less considerable size above, and an expansion or another funnel below, to sustain or rather push back the rectum and bladder which tends to descend. I call them, on account of their shape, "*pessaries en sablières*," hour-glass pessaries.

II. UTERINE PESSARIES.—Some, called "*en gimblettes*," are quite circular, rounded, flattened from above downwards, pierced with a hole in the centre, or slightly hollowed before and behind, so as to figure an 8; or completely elliptical; or lastly, hollowed at the four extremities of the two principal diameters. In England a globular form is given to them. The cup and ball pessaries, "*en bilboquet*," are made of a ring of ivory, supported by three branches starting from a shank, pierced by some holes at its free extremity. Désormeaux hollowed this shank into a central canal to favour the escape of liquids. All these are intended to act on the neck of the uterus even in deviations of the womb, and in virtue of the principle still maintained by Dugès—that, in all cases, the neck of the uterus should be acted on rather than the body.

M. Hervez de Chégoin lays down an entirely contrary principle, viz. that the pessaries should never act but upon the body of the uterus; consequently, he replaces all uterine pessaries by the following. The first is a flat circle, into which enters the neck of the uterus, in order

* The term "procidentia" is generally used by English authors to designate the complete falling down of the uterus outside the vulva prolapsus, being confined to those cases in which the organ has descended into the vagina, but not beyond the vulva.

that the edge of the circle may exactly support the womb. The border of this circle is much larger behind than before; in order, in anteversion, to separate the neck from the posterior part of the vagina; in retroversion to oppose the sinking of the body of the matrix, and to retain the neck which tends to pass forwards. The instrument is supported by a thin, flat shank, with rounded edges, with which to pass and maintain the pessary at a proper height. According to this view, the anterior portion of the circle, or ring, is of no use but to fix the pessary; on which account M. Hervez prefers the following. It is a kind of cylinder hollowed above, in such a manner as to leave a semi-circumference behind, on which the uterus rests, and a gutter in front, to receive its neck. It presents also two lateral hollows, in which the parietes of the vagina may lodge, as they retract on themselves, and help to fix the pessary. But it is only suitable for a very narrow vagina; a very large one requires the first shape.

The principle of M. Hervez de Chégoïn is of great importance; but nevertheless, it should not be taken in too exclusive a light; and the best pessary is that which acts at the same time on the body, and on the circumference of the neck of the uterus. In cases of ordinary prolapsus, there are no pessaries comparable to the infundibuliform gum-elastic pessaries. The caoutchouc has only the inconvenience of becoming easily impregnated with the fœtid matter secreted by the vagina; this inconvenience may be diminished by covering the pessary with a layer of metal, but it cannot be entirely removed. Care must be taken then to withdraw it at intervals, as required, and to plunge it in vinegar and water, or in chlorinated water.

Moreover, the capacity of the vagina, the nature of the displacement, and the conformation of the pelvis should also sometimes modify the shape. For example, I met with a case in which the vagina and vulva were so large, that no funnel-shaped pessary could be retained in it without compressing the bladder and rectum; I succeeded in supporting the uterus with a pessary "en gimblette" of an enormous size. M. Hervez also was obliged, in a case of anteversion, to apply, in front, the largest part of his circle; and, in a case of retroversion, in which the sacrum offered an enormous concavity, the only way in which he could support the uterus was by filling the vagina with a pretty large bottle of caoutchouc. It is just, however, to remark that, for cases of retroversion, M. Moreau had already pointed out the indication, and established the fact, that it is, above all, necessary to fill up the interval that exists between the posterior surface of the uterus and the concavity of the sacrum, or the displacement will be reproduced.

Proceeding of Application.—The woman being placed on her back, with her thighs separated, and moderately flexed, the smallest end of the pessary, smeared with cerate, is passed to the entrance of the vagina; and then introduced from below upwards, and from before backwards, into the cavity of this organ, according to the rules given for the introduction of the speculum. The pessaries "elytroïdes and ellipsoïdes," being wider in one direction than in the other, should be presented flat to the great diameter of the vulva, and so that their pos-

terior border, entered first into the opening of the vagina, may serve to repress the rectum, and the whole surface of the perineum with some force. Their anterior border is then depressed little by little, gliding under the pubic arch, and the instrument then penetrates easily.

When once entered, they should be placed as they are to remain; for instance, the cylindrical pessary should have its concavity forwards, and its convexity backwards; its superior extremity towards the neck of the uterus, and its inferior extremity, which is the largest, across, below the ischii.

The pessary *en bondon* fits lengthwise in the vagina; the *gimblettes* obliquely, one surface forwards, the other backwards; the superior border behind the neck of the uterus; and if the pessary has one diameter larger than the others, it is advised to place this long diameter across, so that it may press on the ischii. This precaution is very useless, and the long diameter immediately becomes vertical; the globular pessary places itself; the *bilboquet* should receive, in its capsule, the neck of the uterus. The greatest difficulty is to keep these pessaries in place; those with a shank are fixed to a cloth, by means of threads passed through the shank, or to a plate applied over the vulva, called by the English "*a shield*," or to a curved spring, fastened to a truss round the pelvis. The funnel-shaped caoutchouc pessary supports itself. In introducing it, the two halves of the circumference are brought together, so as to flatten it laterally, and give it the shape of an ellipsis; one end of this ellipsis is passed into the vagina, and pushed upwards and backwards, into the hollow of the sacrum, in such a way that the other can pass under the pubic arch. When the orifice of the vagina is passed, the pessary regains its shape, and you have only to push it on with the finger as high as you wish.

(11.) *Puncture of the Uterus.*

It is performed in two cases:—1. When, in consequence of congenital or accidental obliteration of the neck of the uterus, the menses are retained in the uterus;—2. When, in a case of irreducible retroversion, it becomes necessary to evacuate the product of conception in order to reduce the uterus, it is performed by the vagina or rectum.

1. *Puncture by the Vagina.*—We use a bistoury, guarded with linen, to within a short distance of its point, a trocar, or sound, containing a sharp stylet (*la sonde à dard*), &c.

A long and slightly curved trocar, such as is used for puncture of the bladder, is the instrument most suitable. Begin by seeking with the finger the traces of the neck in the spot where it should exist; and, if you find it, try to introduce into it a metallic sound slightly curved, with which force the obstacle if possible. If not, introduce by this passage the canula of the trocar with the piercer withdrawn inside it, and, as soon as you touch the obstacle, push at the same time the canula and piercer forwards, taking care to stop when you perceive a want of resistance.

If you cannot find any trace of the neck, perforate the uterus at a point almost corresponding to the axis of the vagina. The canula

should be introduced to it, and applied against the wall to be traversed; with the left hand the surgeon presses on the hypogastrium, and with the right pushes in the piercer and canula, as we have said. When this puncture is made on account of obliteration, a permanent opening is sought to be obtained; for this purpose a gum-elastic sound is passed through the canula, and should be left in; injections may also be made through it (Hervez de Chégoin).

2. *Puncture by the Rectum.*—This proceeding is applicable principally in retroversion, when the thickness of the womb seems much less, and its projection is closer to the exterior than by the vagina. The same precautions should be taken; but as it is important to the object we have in view that the liquor amnii should be drawn off, and consequent abortion be produced—if these liquids do not flow, we may presume that the trocar has penetrated into the placenta, or into the body of the foetus. In this case a probe should be introduced into the canula to free it, and recognize the spot where it has reached; and, if necessary, it should be withdrawn to be pushed farther forwards. The escape of the liquids having been obtained, the canula is withdrawn, the wound closes, and abortion takes place some days afterwards. An endeavour must then be made to reduce the womb to its natural position, either immediately after the puncture, or after the escape of the foetus.

(12.) *Incision of the Neck of the Uterus, or Vaginal Uterotomy.*

Advised and performed by many accoucheurs, during labour, when the orifice of the uterus is absolutely undilatable, or when it rises too high behind; it has also been performed, according to Beale and Louis, for the extraction of uterine calculi, and by Dupuytren for the extraction of certain polypi. It is performed in three ways.

1. *Incision from within outwards by the Orifice.*—Louis proposes scissors, sharpened on their outside edges; others, the probe-pointed bistoury, lithotome caché, &c. The best instrument is the probe-pointed bistoury, with a narrow blade and concave edge introduced into the orifice of the uterus, with which the neck, as it were hooked up, is incised in withdrawing it. (Dupuytren.)

2. *Incision from without inwards, or by Puncture.* (Dupuytren.)—After having fixed the extent to which the incision should be carried, a straight sharp-pointed bistoury, guarded with linen to within half an inch of its point, is plunged in at its limit, and an incision is made with a sawing motion, until the orifice of the uterus is reached.

3. *Incision of the Neck of the Uterus without affecting its Orifice.*—A straight or convex pointed bistoury is used, and that portion of the uterus which presents is incised, layer by layer, with great caution, for fear of wounding the foetus. As soon as the incision will permit, the finger should be introduced to serve as a guide to the probe-pointed bistoury, in enlarging it. An incision of about two inches suffices, as the dilatation will much increase it. M. Velpeau seems to advise directing it from before backwards, and he would have it prolonged in this direction for fear of wounding the bladder. The transverse in-

cision, twice successfully performed by Gaulthier, seems to us much preferable, and incurs no risk of wounding anything.

Appreciation.—The first proceeding seems at first sight far superior; but it has the inconvenience, that we cannot by it make an incision of more than, at the farthest, one-third of an inch; at the same time, however, it is the only one practicable in case of accouchement, the others being dangerous. Perhaps it would be better to make several incisions of less depth (Velpeau); moreover, we need not fear that the head of the fœtus will prolong it too far by laceration.

The second proceeding is preferable, on the contrary, when there is a polypus in the womb. You can make as large an incision as you choose; and the point of the knife, even though pushed into a depth of half an inch, always meets the body of the polypus, which shields the uterus from injury.

The third is allowable only, when the orifice of the uterus rises backwards, and is out of the reach of instruments.

(13.) *Polypus Uteri.*

Anatomy.—In an essay on this subject I divided polypi into five classes.

1. *Vesicular Polypi.*—Similar to the nasal polypi of the same name; they are rare, and grow in the cavity of the neck, or in the proper cavity of the uterus.

2. *Cellulo-Vascular Polypi.*—Some small, soft, spongy, or granular, arise generally from the neck of the uterus or from its cavity; others of greater size are actual fungus, usually numerous, without envelope, or pedicle, liable to bleed, and generally growing again after extirpation, especially in old women. (*Polypes vivaces de Levet.*)

3. *Polypi by Hypertrophy of the Tissue of the Uterus.*—An affection that has been but lately discovered, and of which I have met with an example.

4. *Môliform Polypi.*—These also are rare: they enclose in an envelope formed of the tissue of the uterus, the debris of moles. These two kinds can be distinguished from fibrous polypi, only by dissection.

5. *Fibrous Polypi.*—By far the most frequent of all: they are formed of a more or less thick uterine envelope and a central fibrous body. This fibrous body may be in a fleshy, fibro-cartilaginous, or osseous condition (calculus uteri); sometimes it is softened like pap, hollowed with cavities, or mixed with encephaloid matter. The envelope, more or less thick and vascular, at first adheres to the fibrous body only by a thin loose cellular tissue devoid of vessels, so that enucleation is easy and without danger of hemorrhage. Afterwards adhesions form, first at the inferior part, then at the pedicle itself; and then there are arterial communications, sometimes very considerable, between the fibrous body and uterus. The pedicle is formed usually by the enveloping membrane only; but sometimes there is in the centre a prolongation of the fibrous body.

These polypi generally spring from the cavity of the uterus, rarely from its neck. In the former case, the polypus has been seen to pre-

sent, in addition to its pedicle, a second contraction caused by the constriction of the neck of the uterus. This circumstance may mislead, but it is rare; and it is principally the usual multiplicity of fibrous bodies in the uterus that explains the facility of relapse.

There are six methods of operation:—cauterization—tearing—crushing—torsion—ligature—and excision.

I. CAUTERIZATION.—Advised by the ancients, but almost forgotten by moderns, is useful for polypi of the two first kinds only. Vesicular polypi may be treated with nitrate of silver; the others, especially the *polypes vivaces*, with the actual cautery, potassa, or the nitric oxide of mercury. For the manner of operating, see *Cancer of the Uterus*.

II. TEARING.—It also is scarcely applicable for any but the first kinds of polypi. M. Recamier performed it for a soft and vascular polypus, situated in the cavity of the neck of the uterus, in the following manner:—An assistant leant on the hypogastrium to depress the womb: the operator seized the tumour with a common polypus forceps, guided along the index-finger. He wished to perform torsion; but the polypus tore, and he was only able to bring away a portion of it. He then re-introduced the forceps, but closed; and, seizing the remnants of it between this instrument and his finger, he succeeded after seven or eight attempts in tearing it all away in this manner. The operation lasted eight minutes, and caused only slight pain; but symptoms of metro-peritonitis showed themselves: these were arrested, and the patient was cured.

We read of pretty numerous cases of involuntary tearing off of fibrous polypi, supervening on the least effort, and followed by perfect cure; this is explained by the more or less complete destruction of the pedicle, strangled by the neck of the uterus; but no one has ever thought of establishing it as a method: nevertheless, Dupuytren and Recamier once performed it. The polypus was enclosed in the uterus, and could not be brought down, though the neck of the uterus was incised, and it was pulled with the hook forceps, which only tore it. Dupuytren crushed it unmercifully with the forceps and his fingers; then, when he was tired, M. Recamier took his place, and reduced the tumour to shreds, the filaments of which slipped through the teeth of the forceps. It was not followed by any accident, the remnants came away during suppuration, and a cure was the result.

III. CRUSHING.—Also due to M. Recamier. In a case of soft and vascular polypus of the neck of the uterus, he pressed it against the neck of the uterus with the index-finger, reduced it to a pulp, and thus brought it away in two minutes. The polypus was of the size of the great toe; there was no hemorrhage, and scarcely more pain than in the ordinary “toucher.” The woman was cured in a few days.

Crushing is suited for polypi of the two first kinds only; M. Recamier, having wished to employ it for a fibrous polypus, was obliged to abandon the attempt. Nevertheless, when these polypi have undergone a certain degree of softening (“ramollissement”) recourse is had to the forceps with success, to diminish their size; but then it is only an auxiliary expedient, and not a method of operation. We shall return to it.

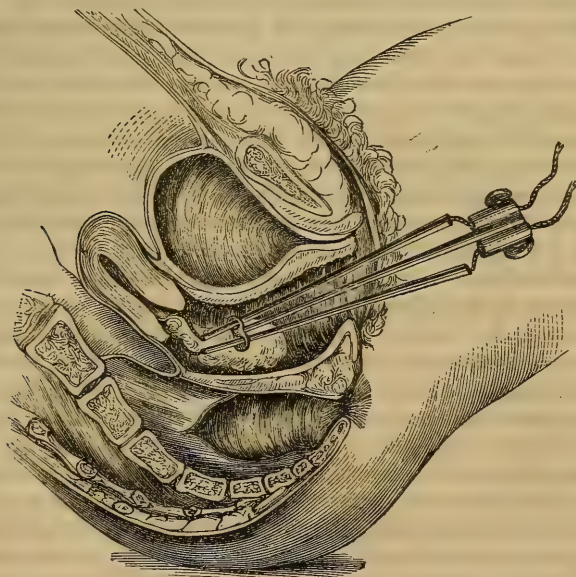
IV. **TORSION.**—The success of torsion, employed for polypi of the nose, sanctions, says M. Recamier, its application to those of the womb; without doubt this is the case, provided that the polypi are of the same nature; but the observations of M. Recamier show that, in this case, torsion is reduced almost always to tearing.

Torsion was applied to fibrous polypi, by Boudou, and on two or three occasions by Dupuytren. It consists in twisting the pedicle gently, and always in the same direction; this may be done with the index and medius fingers of each hand introduced into the vagina. In a thesis, defended in 1753, it is advised to seize the pedicle beforehand, with forceps or pincers, in order to hinder the torsion from communicating itself to the uterus. It is a purely exceptional method, suitable only to those cases in which the pedicle is so thin and slender, that a feeble effort is sufficient to break it.

V. **LIGATURE.**—Until 1742, those polypi only were tied which had descended outside the vulva. Levret passed the ligature into the vagina itself: Herbiniaux had the boldness to apply it even within the uterus.

1. *Ligature of Polypi outside the Vulva.*—It is performed in several ways, either by tying the pedicle tightly in a loop of thread secured

Fig. 24.



Section of Female Pelvis, representing the ligature of a polypus by means of a double canula. The thread is passed round the neck of the polypus by means of the two tubes, as described: the tubes are then brought down into the sockets, and the threads fastened to a small winch at the external extremity of the instrument so that they may be tightened or loosened at pleasure.

by a double knot; or traversing the pedicle with a needle, armed with a double thread, and tying each half separately. The first is the most simple. When the pedicle is large, one ligature frequently does not suffice. Leblanc was obliged to apply as many as four. If the

pedicle does not appear entirely outside the vulva, it should be drawn out by fixing in the polypus the forceps of *Museux*.

2. *Ligature of Polypi inside the Vagina*.—It is performed with instruments, or with the finger. The instruments have been much diversified; they may be reduced to the following:—1. One or two "*porte-nœuds*," consisting generally of a metallic rod, pierced by a hole, through which the thread is passed, at its extremity; or of a metallic tube, through which the thread extends. We prefer those of Mayor, which are simple, elastic rods of whalebone, or steel terminating in crab's claws ("*pattes d'écrevisse*") so that the thread is retained at their extremity firm enough; but the least effort of retraction on the rod suffices to disengage them. 2. A *serre-nœud*, which has been equally diversified in shape; we prefer that of Græfe, modified by Dupuytren; or better still that of Sauter. 3. A ligature, two or three feet long, which may be made of silk, brass wire, or better still of twine, tarred and then soaped.

The woman is placed as for lithotomy, the labia majora being shaved, an assistant leaning on the hypogastrium to depress the womb, and another, if necessary, fixing the polypus with the forceps of *Museux*. The *porte-nœuds*, threaded with the ligature, are conducted to the bottom of the vagina, along its posterior wall, by means of the two first fingers of the left hand, previously placed in it. Having reached the pedicle, the fingers that serve to guide them are withdrawn; and, one in each hand, they are made to describe a semicircle, and embrace the pedicle from behind forwards; or they are both introduced in front, and whilst one remains fixed, the other is carried round the polypus. This done, they are crossed, lest the thread should be displaced; then the ends of the thread are passed into a *serre-nœud*, of some kind or other. The *serre-nœud* is pushed up to the point of union of the two *porte-nœuds*, which are then withdrawn by simple traction, if those of Mayor are used; or by a special mechanism, if those of Desault, or others are preferred. The loop is passed in this direction in order that the *serre-nœud* may be in front, under the pubis. There, in fact, the pedicle is nearer to the vulva; the instrument will not be pressed by the tumour against the vagina: and if a solid, straight *serre-nœud* has been preferred, the curve given to the vagina by the tumour would prevent its resting anywhere else without causing pain and inconvenience. An English surgeon has proposed to conduct the loop with the finger, without the assistance of instruments. He places the middle of the ligature across the extremity of the right index-finger, and fixes it by holding its ends sufficiently tight in the hand. He passes the finger, thus armed, on the pedicle of the polypus; there he disengages the ends of the ligature, and causes each end to make a half turn round the tumour, so as to embrace half or three-quarters of the circumference of the pedicle. This suffices to cause the loop to be properly formed when the *serre-nœud* is threaded with the two ends, and pushed up towards the pedicle; the globular shape of the pedicle retaining the thread *in situ*, and hindering it from descending.

I have endeavoured to simplify this proceeding. Before carrying

the thread into the vagina, its two ends should be passed into the *serre-nœud*. In this manner, whilst the index-finger would maintain a portion of the loop at a suitable height, the *serre-nœud*, which is passed up at the opposite side, would carry the other portion of the loop to the corresponding point. It is only necessary to hold the ends of the thread, at the same time that the *serre-nœud* passes up; and it would not be required to carry it round with the finger, which may sometimes be difficult.

3. *Ligature above the Neck of the Uterus*.—Proposed and performed for the first time by Herbiniaux. It can only be accomplished with *porte-nœuds*, the finger being too short. The proceeding is the same as that for ligature in the vagina; only that care must be taken to make the instrument pass between the pedicle and neck of the uterus, and not to place the ligature around the latter itself.

Cullerier proposed an instrument for raising the ligature as high as desired, after it has been placed, but before it is tightened. It consists in a rod notched like a *porte-mèche*; the notch serves to seize and raise in turn the different parts of the loop.

When the ligature is placed, it is tightened, until the patient complains that it pinches him; but never beyond this point. Too much constriction has been followed by frightful pain (H. de Chégoïn), convulsions (Herbiniaux), and even mortal convulsions (Martin). If accidents of this nature come on, the ligature must be loosened; and if a second and third attempt also fail, it must be given up altogether. If, on the contrary, the patient bears it well, after some days, when the external knot seems loose, it is re-tightened. The polypus comes away after a variable time, according to the nature of its pedicle: from four to six days up to nearly three months. (Leblanc.)

After the polypus is tied, the red discharges cease, if not immediately, at the end of a few days. The strangulated polypus swells, becomes red, violet, and sometimes its veins burst; then it shrivels, becomes livid, and, lastly, putrefies, giving rise to a fetid smell and discharge. If, however, it is very hard, fibro-cartilaginous, or osseous, it scarcely undergoes any change.

When the ligature has come away, all the accidents cease, except in certain rare cases, when they have continued until death (H. de Chégoïn); and the white discharges disappear, unless due to some other cause.

VI. *Excision*.—Advised by all the ancients; performed outside the vulva by Lapeyronie in 1705; by Herbiniaux in the uterus itself; then proscribed; and, lastly, renewed by Dupuytren. For vesicular or cellulo-vesicular polypi it suffices to dilate the vagina with a speculum, and to pass to their root long scissors curved on the flat. The operation varies for the fibrous polypi according as they are already outside the neck of the uterus, or are still contained in the womb.

1. *Excision of the Polypus in the Vagina*.—The woman being placed as usual, an assistant pressing on the hypogastrium, others holding apart the labia majora, a long speculum with a movable hinge, which separates the walls of the canal, and well isolates the tumour, is introduced. It is then seized with a Museux forceps, and the speculum

is withdrawn. The polypus is gently pulled: as soon as possible another forceps is applied above the first and on the opposite diameter. The traction is continued, whilst the woman is told to bear down; lastly, the neck of the womb appears with the pedicle of the polypus. This pedicle is cut with a bistoury or, better, with a strong curved scissors. Two or three strokes of the latter suffice: at most but a few drops of blood escape; the womb immediately rises again, and the cure is completed in a few days.

This proceeding seems to me too complicated. The speculum is in the way, and is of no use. I pass the forceps of Museux on the polypus along the left index-finger. If the polypus yields, and shows its pedicle at the vulva, I excise it with the scissors; if not, I pass a long blunt-pointed bistoury curved on the flat to the pedicle, and cut it with facility by a sawing motion.

2. *Excision of the Polypus in the Uterus.*—Dupuytren tried first to draw out the polypus, producing a semi-inversion (*renversement*) of the womb. If he could not succeed in this, he incised the neck of the uterus from without inwards with the point. M. Lisfranc, instead of pulling the polypus, sometimes passes the hooks on the neck of the uterus itself, to cause the uterus and tumour to descend together, the rest being performed as we have described.

In each case hemorrhage has occurred, though rarely. It is guarded against, when feared, by putting a ligature on the pedicle. When it has taken place, if the simplest remedies against hemorrhage do not suffice, plugging stops it infallibly.

Sometimes the polypus will not descend completely. Then with scissors or a bistoury curved on the flat, guided on the finger, the pedicle is cut even inside the vagina. If it is necessary to push up too high, or if the pedicle, very large, is not distinct from the uterine tissue, the enveloping membrane is incised at some distance, and the fibrous body is detached with the fingers by *enucleation*. The membranous flaps that result contract and cicatrize of their own accord, or are partly carried away by suppuration.

Lastly, sometimes it is impossible either to entirely enucleate or extirpate the polypus. If its envelope has been freely opened, that part which you are obliged to leave will be removed by the suppuration.

Appreciation.—For vesicular or cellulo-vesicular polypi, extraction united to crushing seems the most prompt and easy, and as sure as any other method, excepting for the small mucous polypi springing from the neck of the womb. These last may be treated by caustics; but excision is still better. The “*polypes vivaces*” cannot be remedied in any other way than by the most energetic caustics, or amputation of the neck or body of the uterus.

For the last three classes, or rather for fibrous polypi only, seeing that the others are so rare, torsion being impracticable, the only question is between excision and ligature. When we consider the pain, the convulsions, and the fetid discharges which follow ligature, the slowness of its action, and the inconvenience of retaining a *serre-nœud* in the vagina; and, on the other hand, the simplicity, promptitude, and

facility of excision, the latter is evidently preferable. There is but one objection to it—the danger of hemorrhage. But when this accident is feared, for instance, when an artery is felt pulsating in the pedicle, Dupuytren applied a precautionary ligature. Perhaps in this case it would be more prudent to tighten the ligature first, and not to excise until afterwards; for the hemorrhage frequently does not show itself until some hours after the excision.

Finally, there is a last case, viz. that in which the polypus enclosed in the womb resists all traction, and even incision of the neck. In this case it is proper to apply the ligature, and even, if this is impracticable, to have recourse to bruising with the fingers and hooks.

After many of these operations, polypi of very large size have been stopped by the smallness of the vulva. In case of necessity, the fourchette should be incised backwards, and slightly to one side (Dupuytren); and, and if this does not suffice, the size of the polypus should be reduced by squeezing it with strong forceps or pincers, tearing it with hooks, or cutting it into several pieces with the bistoury. M. Chassaignac, in a case of this kind, conceived the idea of removing a wedge-shaped bit of the polypus; this ingenious means perfectly succeeded.

{14.) *Cancer of the Neck of the Uterus.*

Three methods of operation have been proposed for cancer of the neck of the uterus—*cauterization, ligature, and excision.*

I. CAUTERIZATION.—Extolled especially by Bayle, and founded on this fact of pathological anatomy—that, at the commencement of the ulcer, the tissue of the uterus is healthy at a distance of two and a half or three lines from the ulcerated surface. The patient being placed, and the speculum introduced, begin by cleaning the cancer with pellets of lint passed on long forceps. If the surface is uneven, and covered with vegetations, remove them with bent scissors, or a spoon with cutting edges (Dupuytren; you may in this way destroy the vegetations not only of the neck but even of the cavity of the uterus. When the ulcer is sufficiently cleansed and laid bare, put a bit of lint beneath to catch the superabundant portions of caustic, which, without this precaution, might flow underneath the speculum, and injure the vagina; then apply the caustic, either the arsenical paste (Bayle) or pure potassa, in a cone one inch broad at its base, and fixed in a strong porte-crayon; or the nitric oxide of mercury, a dossil of lint or fine linen being dipped in it and passed up at the end of a forceps. The application lasts one minute, unless the pain is excessive, which is not often the case. Finish by copious injections to wash away and remove the non-decomposed particles of the caustic, withdraw the lint and speculum, and put the patient to bed. After four or six days, re-commence. If the cauterization does not cause any accident, it should be repeated at short intervals, but made more lightly, in proportion as the limits of the disease are approached (Lisfranc).

II. LIGATURE. (Mayor.)—The instruments necessary are, a speculum, a bead or tubular serre-nœud, to which a metallic tourniquet is

fitted, and, lastly, a *forceps-érigne*, a kind of pincers, with separate branches like those of the ordinary forceps, but terminating in straight hooks, joined to the branches at an obtuse angle; each angle is surmounted by a slight projection, which retains the ligature at the moment of its application.

The speculum being introduced, each branch of the instrument is passed in succession as high as possible on the neck of the uterus, pushing back the upper part of the vagina; one in front and the other behind on account of the disposition of the lips of the neck. The hooks are pushed in above the diseased part, and then the ligature is applied. This latter forms a complete loop, the ends of which are previously threaded in the *serre-nœud*; this loop is guided with the finger, or on a bifurcated probe; as soon as it is in place, the tourniquet is sharply and strongly tightened, and the hook forceps is removed. During the day it is again tightened once or twice, so that after forty-eight hours the constriction is tight enough to cause complete mortification of the strangled parts, and allow of the removal of the apparatus.

III. *Excision*, sometimes also called *resection* or *amputation*.—It was proposed, according to Baudelocque, by Lauvariol, about the year 1780, and performed for the first time by Osiander in 1801. He drew down the neck of the uterus to the vulva by means of needles, armed with double threads, passed quite through it. Dupuytren substituted the forceps of Museux. M. Lisfranc has pointed out with more precision all the circumstances relating to the operation. We shall not speak of the proceedings (by machine) of MM. Hatin and Colombat. The proceeding we are about to describe is that of Osian-der, modified by Dupuytren and Lisfranc.

Anatomy.—The neck of the uterus in the normal condition projects from three and a half to seven lines into the vagina, and is of variable size. On one occasion Lisfranc found it entirely wanting; the vagina that surrounds it is thin, in contact on one side with the rectum, on the other with the bladder, and continuous above with the uterus. The peritoneum descends pretty low on each surface of the uterus; in front, it is at a distance of ten lines from the extremity of the os tincæ, behind one inch. This distance varies according to the greater or less length of the projection of the neck; the vagina may, however, be always detached from it to the extent of more than six lines without danger of reaching the peritoneum; behind, the vagina rises higher, and there is also less space between the peritoneum and it; moreover, the neck of the uterus is completely unprovided with large arterial or venous vessels.

Operation.—The instruments are a bivalve speculum, a Museux's forceps, a bistoury curved on the flat, blunt-pointed, and with a convex edge; or strong scissors curved on their flat. If the bistoury is used it should be guarded with lint to within about two lines of its extremity. The woman being placed in the proper position, the speculum is introduced closed; then its branches are separated so as to extend the vagina, and prevent its folds from reaching in front of the neck of the uterus; and also to permit the neck to enter the

speculum, and the instruments to act freely. The tumour is carefully wiped; then the forceps of Museux closed are passed to the *os tincae*, and, after having opened them and engaged them between the neck and speculum, their hooks are fixed in two diametrically opposite points, with the precaution of pushing them up slightly as they are pushed in, to follow the ascent of the organ, and not seize it too low down; then the speculum is withdrawn. Gradual traction is exercised on the tumour, first in the axis of the brim, then in that of the outlet, and thus the neck of the uterus is brought down to the vulva. There the teeth of a second forceps are applied above the first in the opposite direction; and the operator feels with the index-finger the point where the vagina is inserted in the uterus, which is easily recognized by the presence of a kind of ring, above which a kind of vacuum is felt, on pressure. These forceps are confided to an assistant, who stands like the surgeon between the patient's thighs, but on the right side. The surgeon on the left has the hooks raised to cause the posterior part of the neck to project, passes behind it the left index-finger semi-flexed, with its palmar surface downwards, measures with this finger the height at which the section must be made, and guides the bistoury under the finger, which serves as a support for it. The assistant depresses the hooks successively in different directions, to cause all parts of the diseased organ to project in turn, augmenting this projection in proportion as the disease extends farther, but without pulling too much or tearing the tissues. The bistoury should be used in a sawing manner, and with small cuts, not to injure the labia majora; the resistance of the tissues renders this step of the operation rather difficult.

If scissors are used (Dupuytren) they should be passed, alternately, above and below, and on the sides, their concavity being turned upwards; and they should be made to act as much as possible on the sound parts, beyond the limits of the disease. If the cancer is too extensive to enter the speculum, it must be dispensed with, and the hooks be guided along the finger. The same would be the case if the speculum could not be introduced without rubbing the tumour, and causing it to bleed: the blood would mask the objects. In all cases it is important that the hooks be not fixed in parts too much softened. When the disease extends very high, M. Lisfranc successfully uses a straight bistoury, with which he makes an anterior and posterior semi-lunar incision, scooping out a kind of cone from the body of the womb itself.

The most difficult, and in many cases the most painful, step in the operation is the depression of the womb. The tractions must be proceeded with slowly, during ten, twenty, and thirty minutes if necessary.

Lisfranc has quite failed in five cases, and has been obliged to leave the operation unfinished. This resistance is generally attributed to the engorgement of the broad ligaments: M. Tanchou was the first who explained; and I have since demonstrated that the so called ligaments of the uterus, whether broad or round, have nothing to do with it; it seems to me that the resistance is owing to the superior pelvic

fascia, and principally to its lateral, and slightly posterior parts. M. Lisfranc stated that he reached his ninety-ninth operation without meeting this invincible resistance; and that it was in a series of thirteen fresh operations that he met with it five times.

After the operation, the blood usually flows, and a considerable quantity is lost, which diminishes the chance of inflammation. Lisfranc allows it to flow without being alarmed even at syncope. But if the woman becomes very feeble, or if the blood flows in streams, plugging must be resorted to.

This accident was at first thought rare; in fact, Lisfranc had recourse to plugging in but three out of thirty-six cases; in his later operations this necessity was more frequently met with. About the tenth day all danger of hemorrhage ceases; cicatrization proceeds but slowly, principally because that, in any wound of the uterine tissue, the edges do not yield to the contraction of the cicatrix; whence it follows that the new substance has more space to cover, and is longer in being completed; it takes on an average, six weeks or two months. The cicatrix then presents numerous folds, radiated, and of a marked red tinge; and the vagina forms beneath it a sort of ring which conceals it, but which the finger easily dilates in reaching it. Conception and accouchement are accomplished with as much facility as before. Moreover, in this operation, as in all those which are tried for cancerous affections, the number of successes varies singularly, according as they are counted immediately after the cicatrization, or several years afterwards; out of the ninety-nine first operations, M. Lisfranc reckoned eighty-four cures.

Two patients died of acute peritonitis, two sunk under cancer of the liver or spleen, eleven under relapses more or less speedy; not one from hemorrhage. Lastly, at a more remote period, six of the women cured were carried off by consecutive affections of the lungs. It is certain that a considerable portion of these cures were not lasting; and in the subsequent operations hemorrhage caused some deaths.

Appreciation.—Cauterization is too painful and tedious, and requires to be frequently repeated; it also often requires the aid of cutting instruments, making two operations instead of one; it is also more likely to cause metritis or peritonitis. Ligature, which is less dreaded by the patient, seems also likely more frequently to produce consecutive inflammations. Excision has the objection of causing hemorrhage; but this accident is of but slight consequence, and is more frequently serviceable than injurious. Excision, then, deserves preference as the general method.

When the neck is small, and the ulcerations superficial, cauterization is preferable (Lisfranc). Lastly, it is a precious resource:—1. When the excision has not been able to reach high enough. 2. When subsequently the wound has a tendency to regain the cancerous appearance. 3. In the far more serious cases, when the tissues are so softened and friable, that it is impossible to seize and fix them.

(15.) *Extirpation of the Uterus.*

It is performed in three different cases:—1. When the uterus has

descended outside the vagina. 2. When it is inverted. 3. Whilst it retains its natural position.

I. EXCISION OF THE UTERUS DESCENDED OUTSIDE THE VAGINA.—In this case have been employed:—1. *Pure and simple ligature*. 2. *Multiple ligature*, by means of a needle armed with a double thread, with which the tumour is traversed at its origin. 3. *Ligature, immediately followed by excision*. 4. *Excision, pure and simple*.

All these methods reckon successful and unsuccessful cases. It should be remembered that, in complete prolapse of the womb, the vagina also is completely inverted; that, in removing the tumour at its origin, the vagina and uterus are removed together. Lastly, that the bladder or intestine may have followed these two organs in their displacement. We therefore advise the adoption of the following proceeding.

Proceeding of Operation.—Circularly incise the vagina as far down as the disease allows, gently and cautiously down to its external cellular tunic; dissect it up, reflecting it like the skin in an amputation; push back the bladder or intestines, if you meet them, beyond the reach of the instruments; detach the womb, if possible, by enucleation, and without opening the peritoneum; or open that membrane cautiously; and, lastly, divide the lateral attachments of the womb by which its vessels pass to it. The lateral attachments may be all tied together before they are cut; or, better, the arteries may be tied immediately after they are divided; and, lastly, the operation is terminated, uniting by suture the wound in the vagina, so as to shield the peritoneum from contact with the air. Langenbeck once had recourse to an analogous proceeding; having found the bottom of the womb healthy, he carefully separated from it the diseased parts, and thus avoided opening the peritoneum; the woman recovered.

II. EXTIRPATION OF THE INVERTED UTERUS.—The same methods have been advised, and put in practice, here as in complete prolapsus; one would be inclined to say that authors have not seen the slightest difference between the two cases.

Anatomy.—The extirpation may be performed on the uterus itself, beneath its neck; in which case the body of the uterus is the only part removed. It may be performed above, on the vagina, when the latter is inverted and diseased, and then the uterus is removed entire. In each case it is possible for the bladder or intestines to be affected by the excision or ligature. Consequently, we advise the following proceeding.

Operation.—Incise the uterus layer by layer down to its peritoneal membrane; open the latter as cautiously as you would an hernial sac; push back the viscera it contains; and then, only, finish the excision or apply the ligature. One advantage of this mode of proceeding is, that if the cancer, for instance, is confined to one part of the substance of the uterus, it can be removed without having recourse to complete extirpation, and without opening the peritoneum. Moreover, when extirpation is necessary, excision may be tried first: should hemorrhage necessitate the application of a ligature *en masse*, it will still not be too late.

III. EXTIRPATION OF THE UTERUS IN ITS NORMAL POSITION.—Proposed by Wrisberg in 1787; described by Gutberlat in 1814, and performed for the first time, in Germany, by Sauter (1822), in England by Blundell (1828), in France by Recamier (1829). In 1832 there were well-confirmed reports of twenty cases, four of which were successful. It is performed by three principal methods :—Extirpation through the hypogastrium, extirpation through the vagina, and dissection by the vagina, without opening the peritoneum. Ch. Wenzel also proposed in 1816 to draw down the uterus outside the vulva, and tie it above its fundus. But he had not even tried his proceeding, which seems impracticable, on the dead subject.

I. HYPOGASTRIC METHOD.—Proposed by Gutberlat, put in execution by Langenbeck in 1825. Having incised the linea alba from the symphysis pubis to two inches below the umbilicus, and opened the peritoneum, he seized the womb with his left hand, an assistant keeping back the intestines and bladder; introduced a pair of long scissors closed, cut the broad ligament on the right side, almost entirely detached the womb, drew it out from the abdomen, and destroyed its last connections with the bistoury. The operation only occupied seven minutes.

This proceeding, which is easy enough, is simpler than that of Gutberlat, who had a special instrument for fixing the uterine neck; and particularly than that of Delpach, who would have the womb previously separated from the bladder through the vagina.

2. VAGINAL METHOD. *Proceeding of Sauter*.—The bladder and rectum having been carefully emptied, the index and middle fingers of the left hand are introduced into the vagina; a scalpel is then passed along these fingers, and made to gently incise the vagina on the uterus on the side next the bladder. The cellular connections are gradually dissected, and the peritoneum is thus opened. Then the broad ligaments are divided; the womb, hooked down by its fundus, is anteverted downwards and forwards, and drawn out of the vulva; then its posterior attachments are completely divided. If the intestines protrude, an assistant retains them, and they are reduced after the operation. No ligature is applied, the loss of blood being inconsiderable. An operation of this kind performed by Siebold, occupied but fifteen minutes; but it is usually longer.

It has also been attempted to incise the vagina laterally (Siebold); or at its posterior side, to retrovert the uterus (Langenbeck); or, lastly, circularly. The fourchette and perineum have been divided previously to afford more space (Langenbeck and Lizars). It has been attempted to draw down the womb by means of hooks or ligatures fixed in its neck (Bramer and Récamier): this is not always possible; Sauter could not effect it. The fundus of the uterus has been seized with a hook or ligature (Siebold and Blundell). Scissors and the straight button-pointed bistoury have been used for cutting the broad ligaments; and a bistoury sharpened like a file has been advised. Blundell incises the vagina behind, and makes a longitudinal incision, which he enlarges with his fingers, with the transverse incision. M. Récamier incises it in front; after the first incision he pushes away the cellular

tissue with his fingers down to the peritoneum, incises only the two superior thirds of the ligaments first, and by means of a curved needle mounted on a handle and pierced at its point, passes a ligature on the inferior third, which contains the uterine artery. Siebold conceived the ingenious idea of placing a sound in the bladder, to warn the operator of his position, and thus prevent its being wounded.

In fine, the proceeding of Sauter is the easiest and most simple. The vagina can be divided in front with more facility than behind, because it is not so high. There is not more danger of wounding the bladder by it than by any other, and ligature does not seem necessary, as so little blood was lost when it has been dispensed with. There is no reason why we should not combine with it any well-tried and possible improvements, such as bringing down the uterus beforehand, dissecting with the fingers, etc. For the less important details, you may refer to *excision of the neck of the uterus*.

3. METHOD OF M. DUBLED. *Extirpation by Dissection without opening the Peritoneum*.—Imagined by Sauter, who, however, could not apply it on the living subject. It was performed by M. Dubled in the following manner.

The neck of the uterus being seized and brought to the vulva with a Museux's forceps, the vagina is separated from the uterus in front, and behind with the bistoury and fingers; the inferior third of the broad ligaments is included in a ligature, and they are then cut near the uterus; then the uterus is more forcibly brought down, being now only retained by the peritoneum at its fundus, and all the diseased portion removed with the bistoury, the healthy parts being left.

The advantages of these three methods are compensated by their difficulties. The last certainly leaves the peritoneum uninjured; but how can we be sure that all the diseased part has been removed? The hypogastric method is more easy, but it necessitates two openings in the peritoneum. The vaginal method is that which seems to be most preferred in the present day.

SECTION III.—OBSTETRIC OPERATIONS.

We comprise under this title the operations for extraction of the fœtus, rendered necessary by the small size of the pelvis. They are four in number. 1. Those by which an artificial accouchement at seven or eight months is procured. 2. Symphysiotomy. 3. Section of the pubis. 4. The Cæsarian operation.

(1.) *Induction of Premature Labour.*

Two principal proceedings are employed.

I. DILATATION OF THE NECK OF THE UTERUS.—It is produced by means of a small plug of sponge rather more than an inch long, and about the diameter of a quill, traversed through the centre by a loop of thread, and introduced by one end in the canula of a trocar, which serves as a conductor to direct the other end into the neck of the uterus. The index-finger having been introduced into the vagina, the canula thus armed is conducted along its palmar surface; the end

of the plug is engaged in the orifice of the neck; and by pushing forwards the canula, and gently rotating it, the membranes are reached. The sensation felt on striking against these membranes, and the total absence of pain during the shock, inform us that we have penetrated far enough. The sponge is then pushed out of the canula by means of a stylet; then the canula is withdrawn, and the two bits of thread hanging out of the vagina are fixed to the thigh.

The labour-pains come on, and then disappear; this is the indication that the sponge has produced its effects, and should be changed. Another plug is then introduced, as long and large as the neck will allow; then a third and a fourth, until well-marked contractions of the womb show the commencement of labour.

II. PUNCTURE OF THE MEMBRANES.—It is performed by means of a curved trocar, or sound, containing a sharp stylet introduced through the neck of the womb: the liquor amnii comes away, and after twenty-four or thirty hours labour usually commences.

Appreciation.—Puncture is the most prompt. The sponge is the safest, both for the mother and child. It has been proposed to substitute, for the sponge, frictions on the uterus, round the neck; and detachment of the membranes from the neighbourhood of the os uteri; these means are not active enough, and cannot be compared with the two preceding.

(2.) *Symphysiotomy.*

There are two proceedings; one by ordinary, and the other by subcutaneous, incision.

ORDINARY INCISION.—The patient being laid on the right edge of the bed, and the hair previously shaved off, the surgeon standing on the right makes with a scalpel on the median line a longitudinal incision, commencing a little above the symphysis and reaching to the clitoris. It is better, however, to incline the incision a little to the side, between the summits of the great and small labia, and even to separate from the ramus of the pubis one of the roots of the clitoris to avoid dangerous lacerations; afterwards, all the soft parts being divided down to the bone, the cartilage of the symphysis is sought for and divided from before backwards, care being taken to remain always master of the instrument, and not allow it to wound the bladder. Dupuytren used a strong knife, fixed on its handle, and blunt at its extremity. He advises, also, to divide the triangular ligament placed beneath the symphysis, by grazing the descending ramus of the pubis.

SUBCUTANEOUS SECTION. *Proceeding of M. Imbert.*—After having separated the clitoris from the arch of the pubis, and thus penetrated behind the symphysis, a strong button-pointed bistoury with a convex edge is passed by this incision behind the latter, its edge turned upwards, and the symphysis is divided from below upwards, and behind forwards. To procure the requisite separation, it is almost indispensable to cut one of the roots of the clitoris. Immediately after the operation, a separation to the extent of from half to an inch is produced, which may be augmented still more by using the thighs as

levers to separate the iliac bones. But it should not be carried too far, for fear of causing large rents in the sacro-iliac symphysis.

(3.) *Section of the Os-Pubis.*

Proceeding of Deschamps.—As the pubis is often divided in mistake for the cartilage in the operation of symphysiotomy, M. Deschamps has advised us to carry the saw in all cases on the body of the bone itself, and a little outside the symphysis; a proceeding the utility of which is not very evident.

Proceeding of M. Galbiati.—This surgeon has proposed, and performed at Naples, the double section of the pubis; he says that he has convinced himself, by experiments made on the dead bodies of healthy but deformed women, that when the sub-pubic diameter is more than one and one-fifth of an inch long, the single section suffices, which seems exaggerated; but, in all cases below one and one-fifth of an inch, the double must be made. This operation is performed in two ways. A longitudinal incision, one inch and a half long, uncovers the portion of the pubis next the cotyloid cavity; the bone is rasped at this point and cut with toothed chisels; an incision of the same extent serves to divide in the same manner the ascending ramus of the ischium. The ilium, being thus divided on one side, is separated from the other by symphysiotomy, performed by the ordinary proceeding.

When there is reason to think that the portion of bone thus detached will not suffice, instead of dividing the symphysis, the section of the pubis, and the ascending ramus of the ischium, is repeated on the other side. The operation on the living subject occupied one hour, although there was but one small artery to be tied. It is probable that it might be done in a shorter space of time; it seems also that the death was owing to their having allowed the patient to wear herself out in useless efforts for two days, instead of immediately applying the forceps.

If the delivery were hastened as much as possible, it seems that this operation, though frightful, has more chance than the Cæsarian operation; and we think it ought not to be rejected without fresh experiments.

Subcutaneous section of the sacro-sciatic ligaments has also been performed lately with the view of enlarging the outlet. A very useless operation, showing merely a great desire to operate.

(4.) *The Cæsarian Operation.*

It is sometimes performed on the woman after death; in which case the only rule is to incise freely, to extract the child more quickly and safely; sometimes on the living female, when there are two methods.

FIRST METHOD.—Its object is to reach the body of the womb by dividing the peritoneum; it comprises three proceedings, according to the places in which the incision of the abdominal parietes is made.

1. *Lateral Incision.*—The incision is made between the external edge of the rectus muscle on the right side and a line that would ascend

from the anterior-superior spine of the ilium to the anterior extremity of the last rib. The woman being placed on the edge of the bed, sufficiently covered, with her head and chest moderately raised, and the knees slightly flexed, an assistant is specially charged with fixing the womb by lateral pressure, from below upwards, to circumscribe in some measure the uterine tumour, and prevent the escape of the intestines. This done, the integuments are extended with the thumb and fingers of the left hand; or a transverse fold is made in them, and an incision with a scalpel, extending from the level of the umbilicus, to within an inch of the pubis, about six inches in length. The aponeuroses, muscles, and peritoneum, are successively divided; the womb, laid bare, is cautiously opened, and the index-finger is immediately plunged into the opening, serving as guide for the button-pointed bistoury, with which the incision is enlarged.

2. *Incision of the Linea Alba.*—The incision should extend along the linea alba, from the umbilicus, which should not be injured, to near the pubis, according to the length thought necessary. The rest of the operation is performed as in the first proceeding.

3. *Transverse Incision.*—This incision is made transversely, as its name indicates, between the rectus muscle and the vertebral column, to the extent of five inches; more or less high, according to the elevation of the womb. It is made, in preference, on the side on which the womb is most prominent. The rules are the same as for the other proceedings.

SECOND METHOD.—Its object is to reach the neck of the womb without injuring the peritoneum; it comprises two proceedings. A third, which consists in opening the vagina instead of the neck of the womb, also belongs to this method by detachment of the peritoneum.

First Proceeding.—Physick, having remarked that, in pregnant women, the peritoneum is easily separated from the bladder and neighbourhood of the neck of the uterus, thought that by means of an horizontal incision, made immediately above the pubis, this membrane might be detached, and the neck of the womb be reached, and opened without injuring the peritoneum.

Second Proceeding.—Ritgen, with the same intention, advises to incise the attachment of the broad abdominal muscles, transversely above the crest of the ilium, to detach the peritoneum as far as the brim of the pelvis, and there to open the neck of the womb.

Third Proceeding.—Lastly, M. Baudelocque commences his incision near the spine of the pubis, and prolongs it parallelly to Poupart's ligament, beyond the anterior-superior spine of the ilium on the side opposite to that to which the womb is most inclined. He divides the abdominal parietes without cutting the epigastric artery; pushes back the peritoneum from the iliac fossa into the hollow of the pelvis; exposes the superior end of the vagina, which he divides; and then attempts to bring the neck of the uterus into relation with the wound in the abdomen.

Appreciation.—The second method has been but once attempted, and then by the proceeding of M. Baudelocque, unsuccessfully. It should, in our opinion, be tried principally by the proceeding of

Physick, the bladder having been previously carefully emptied. As to the first, the lateral and transverse incisions, by which the recti muscles were to have been avoided, fall exactly on these very muscles; and authors, who have all copied in describing them, have fallen into the error of confounding the disposition of the abdominal parietes in pregnancy, with their relation when not distended. In a woman, at her full time, the linea alba is usually from three to four inches broad, on a level with the umbilicus; and it is the lateral muscles that furnish least in the expansion of the abdomen. Consequently, the longitudinal incision of the linea alba should be preferred; or, at farthest, an oblique incision, commencing on a level with the umbilicus, two inches outside it, and terminating below on the median line.

After the extraction of the fœtus and placenta, injections are passed through the vagina, to wash away the coagula, and then the abdominal wound is closed by the suture. If any vessels of these parietes have been wounded, they must be tied; as to those of the womb, its contraction, which should be promoted, is sufficient to greatly diminish the wound and vessels at the same time, and prevent any hemorrhage.

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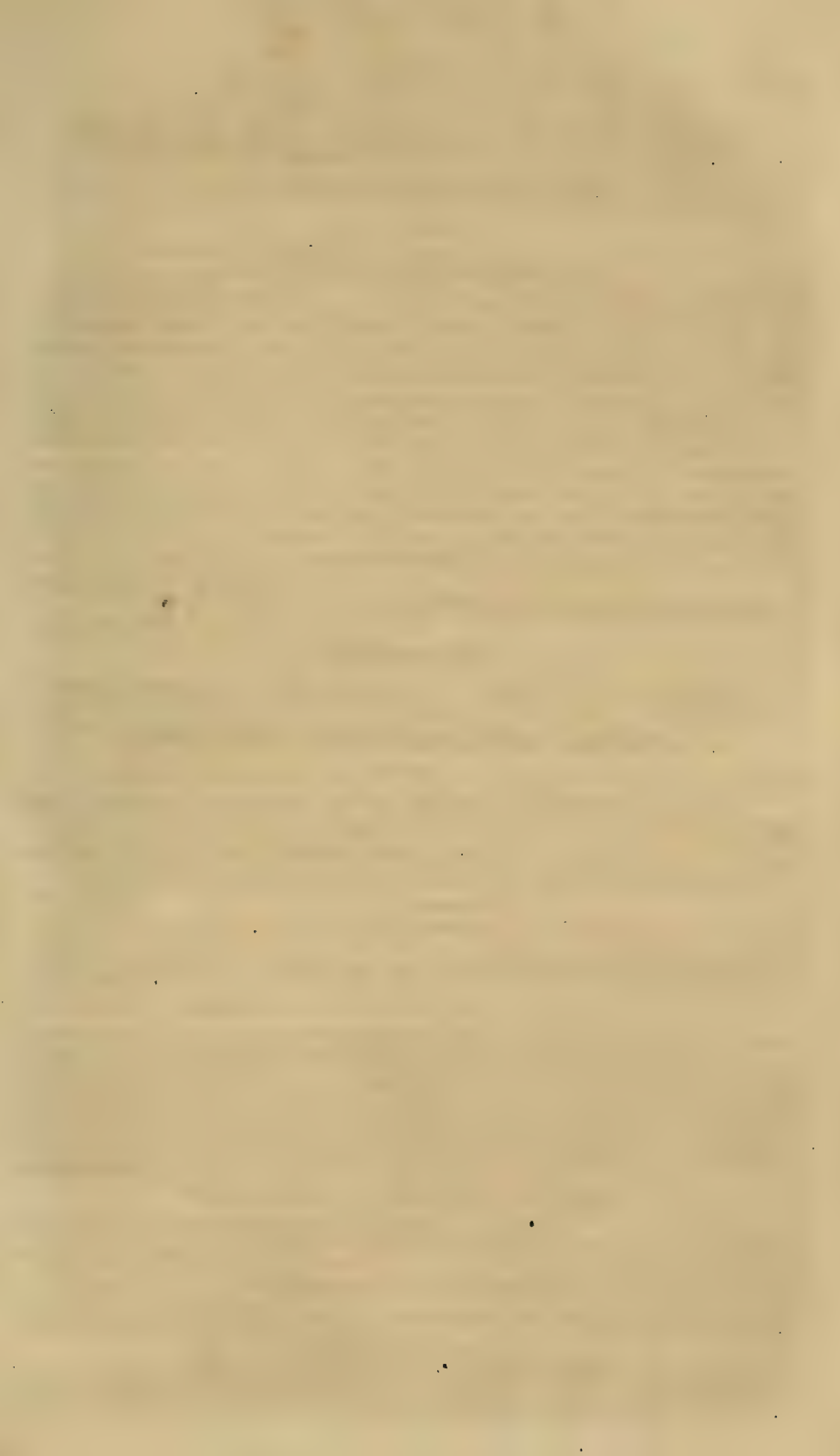
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